GEOTECHNICAL INVESTIGATION REPORT

PERMANENTE CREEK FLOOD PROTECTION PROJECT
RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

For

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GEOTECHNICAL INVESTIGATION REPORT
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1. INTRODUCTION

This report presents the results of our geotechnical engineering investigation for the proposed "Permanente Creek Flood Protection Project - Rancho San Antonio Basin" in Cupertino, California, hereinafter referred to as "PROJECT". The work was performed in general accordance with the scope of work outlined in our proposal to Hatch Mott MacDonald (Designer). The approximate location of the project site and its vicinity are shown on the Project Location Map, Plate 1.

The geotechnical recommendations presented in this report are intended for design input and are not intended to be used as specifications. In addition, the data provided in this report including these geotechnical recommendations should not be used for bidding purposes or for construction cost estimates. If the report is provided as a reference document, any interpretation of the data and recommendations should be the sole responsibility of the user and PARIKH Consultants, Inc. (PARIKH) shall not be liable for any consequences.

2. PURPOSE AND SCOPE

The purpose of this investigation was to evaluate the general subsurface conditions at the project site, to evaluate their engineering properties, and to provide geotechnical recommendations for basin design, foundation design of the concrete culvert and structural pavement design of the proposed project.

The scope of work performed for this investigation included a review of the readily available soils and geologic literature pertaining to the site; site reconnaissance; obtaining representative soil samples and logging soil materials encountered in the soil borings; laboratory testing of the collected soil samples, performing engineering analyses based on the field and laboratory data, and preparation of this report.

3. PROPOSED CONSTRUCTION

The project is to provide enough storage capacity to adequately reduce downstream system flows of the Permanente Creek. The facility at Rancho San Antonio County Park will consist of two separate storage basins. A 91 acre-foot basin (referred as the North Basin) is located north of The Gate of Heaven Cemetery and on the east side of Permanente Creek. A smaller 13 acre-foot basin (referred as the South Basin) is located to the south of the large basin and on the west side of the Permanente Creek. The project generally includes the following:

- The project site will be excavated to a maximum depth of approximately 15 feet with side slopes of 2(H): 1(V) or flatter for the fill slope and 4(H): 1(V) or flatter for the cut slope. Trees and vegetations will be planted on the side slopes of both North Basin and South Basin. It is recommended that the condition of the basin side slope should be regularly monitored and any sign of instability should be reported and mitigation measures to be implemented.

- A meandering low flow channel will be constructed (mainly within the North Basin and South Basin) for the wetland and drainage during the rainy season.

- The existing hiking trail would be realigned with the South Basin.

- An extended parking lot near Cristo Rey Drive.

- An inlet structure will be located near the southwest corner of the basin site along the Permanente Creek. Soil from the detention basin area would be placed on the west bank of the creek and vegetated with native trees in order to ensure flow would be contained in the creek. Flows in excess of the design flow would spill into a side channel and to be transmitted to the basins through the inlet pipes and swale.

- The outlet would be through a 24-inch Reinforced Concrete Pipe (RCP) at the northwest corner of the site, which would drain to an outfall under the existing pedestrian bridge just south of the site.

- An 84-inch Corrugated Metal Pipe (CMP) will be constructed between the control structure in the south to the North Basin. The total length of the 84-inch CMP will be approximately 1,420 linear feet.

- A 9.5-foot by 5-foot concrete box culvert will be constructed underneath the maintenance road to regulate the downstream discharge.

- Wing walls will be installed on both sides and on both upstream face and downstream face of the box culvert.

Some of the above features are shown on Plate No. 6, “Rancho San Antonio – Site Plan, Survey Control, and Drawing Layout Index”. More details of the proposed project are provided in the”60% Design” Plans dated April 16, 2012. Our recommendations presented in this report are based on the above information. Any major deviation should be reported to PARIKH for further consideration.

4. SITE CONDITIONS

The project site is located on the southeast side of the Rancho San Antonio County Park in the foothills below Skyline Ridge off Cristo Rey Drive and in close proximity to Interstate 280. Rancho San Antonio County Park is owned by Santa Clara County Parks and Recreation Department and operated by the Mid-Peninsula Open Space District.

Currently the project site is mainly an open space with the Gate of Heaven Cemetery located on the southeast side. The Permanente Creek is located on the southwest side of the project site. The creek is covered with trees and bushes on both sides. There is an existing trail between the open space and the Permanente Creek. There is an existing natural gas line crossing the site. Water wells and pipes serving the cemetery would be relocated out of the excavation area.

The topography of the project site is generally sloping up in the north-south direction, starting from about Elev. +400 feet at the northern end to about Elev. +445 feet at the southern end. The site also slopes up starting at the northeastern edge of the North Basin towards the east.

5. FIELD EXPLORATION AND LABORATORY TESTING

Based on the plans, discussions with the designer, six exploratory borings (RS-B-1 through RS-B-6) were drilled in August 2010. Additional five exploratory borings [RS-B-3(W) and RS-B-7 through RS-B-10] were drilled in June 2011 due to the proposed expanded basin on the south side and extended parking lot on the north side. These soil borings were drilled to an approximate depth between 30 feet and 60 feet below the existing ground surface. The locations of the borings and the boring logs of the materials are shown on Plate 2 and in Appendix A, respectively. Monitoring well was installed at Borings RS-B-3(W) and RS-B-4(W) after drilling. The screen depth was from 15 feet to 40 feet for Boring RS-B-3(W) and from 20 feet to 40 feet for Boring RS-B-4(W).

All the test borings were drilled with a truck-mounted drill rig using 8-inch diameter hollow stem auger. The soil samples were obtained from the borings during drilling at various depths by driving a 2.5 inches I. D. Modified California Sampler or a 1.375 inches I.D. Standard Penetration Sampler (ASTM Test Method No. 1586). The sampler was driven into the subsurface soils under the impact of a 140-pound hammer having a free fall of 30- inch. The blow counts required to drive the sampler for the last 12 inches are presented on the "Log of Borings", Appendix A. (When correlating standard penetration data in similar soils, the blow counts for the Modified California Sampler can be taken as roughly twice that for the Standard Penetration Test sampler in similar soils). Pocket penetration tests were also performed on clay samples to evaluate their consistency. The samples were sealed and transported to our laboratory for further evaluation and testing. The borings were drilled under the technical supervision of our engineer, who visually classified in the field (according to the Unified Soil Classification System) and continuously logged the soils encountered during drilling. The engineer supervised the collection and transportation of soil samples at various depths for further evaluation and laboratory testing. All the borings were grouted

The following laboratory tests were performed on selected soil samples collected during field exploration to evaluate the physical and engineering properties of the subsurface soils at the project site:

a) Laboratory determination of Moisture-Density (ASTM D-2216).

b) Atterberg Limits (ASTM D-4318).
c) Grain Size Distribution Analysis (ASTM D-420).
d) Unconfined Compression Test (ASTM D-2166).
e) Triaxial Consolidated Undrained Compression Test (ASTM D-4767).
f) Corrosion Test (California Test Method T-643).
g) R-Value Test (California Test Method T-201)

The laboratory test methods and test results are presented on plates included in Appendix B. Laboratory data of moisture contents, total density and unconfined compression tests are presented on the Log of Borings.

The boring logs presented in Appendix A were prepared from the field logs which were edited after visual re-examination of the samples in the laboratory and results of classification tests on selected soil samples as indicated on the logs. The abrupt stratum changes shown on these boring logs may be gradual and relatively minor changes in soil types within a stratum may not be noted on the boring logs due to field limitations.

6. SUBSURFACE SOIL CONDITIONS

Based on the soil borings information, the subsurface soil conditions at the boring locations generally consists of interbedded layers of medium dense to very dense sand/gravel and stiff to hard lean clay. Approximately 10 feet of soft to firm lean clay was encountered at the top of Boring RS-B-1. Pockets/lenses/layers (approximately 5 to 10 feet) of medium stiff lean clay were encountered in Borings RS-B-3, RS-B-7, RS-B-8 and RS-B-9 at shallow depth.

Groundwater was recorded at approximate depths between 13.5 feet and 27 feet below existing ground surface (between approximate Elevation +380 feet and +400 feet) in Borings RS-B-3(W), RS-B-4(W), RS-B-6 through RS-B-8 and approximate depth of 13 feet below existing ground surface (approximate Elevation +424 feet) in Boring RS-B-1 during drilling in August 2010 and June 2011. Maximum groundwater level was measured to approximate Elevation +406 feet in the monitoring well installed in Boring RS-B-4(W) and approximate Elevation +395 feet in the monitoring well installed in Boring RS-B-3(W).

The groundwater level is anticipated to vary with the passage of time due to seasonal groundwater fluctuations, fluctuation of water level in Permanente Creek, surface and subsurface flows, ground surface run-off, and other environmental factors, which may not be present at the time of the investigation.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the subsurface soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional engineering services to attain properly constructed project. We, therefore, recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required during construction.

7. GEOLOGY

General geologic features pertaining to the site and its vicinity were evaluated with reference to the Geologic Map titled “Quaternary Geology of Santa Clara Valley, Santa Clara, Alameda, and San Mateo Counties, California. A digital database by E.J. Helley, R.W. Graymer, G.A. Phelps, P.K. Showalter, and C.M. Wentworth, 1994”. Based on the map, the site is primarily underlain by Alluvial Fan and Fluvial Deposits (Holocene) (Qhaf) and Santa Clara Formation (QTsc). A geologic map of the project area is shown on Plate 3. Description of the main geologic units is as follows:

Qhaf - Alluvial Fan and Fluvial Deposits (Holocene) – Alluvial fan deposits are brown or tan medium dense to dense, gravely sand or sandy gravel that generally grades upward, to sandy or silty clay.

QTsc- Santa Clara Formation (Pleistocene) – It underlies the Quaternary alluvium. It is composed of gravel, sand, silt and clay with various mixtures of grain sizes.

8. EARTHQUAKE CONSIDERATIONS

8.1 Seismic Sources

The project is located in a seismically active part of Northern California. Many faults exist in the regional area. These faults are capable of producing earthquakes and may cause strong ground shaking at the site. Faults in the vicinity of the site with a moderate to high potential for surface rupture include the Cascade Fault, San Andreas Fault Zone and Monte Vista Shannon Fault Zone. The attached Fault Map (Plate 4) presents the locations of the fault systems relative to the project site.

The maximum earthquake magnitudes (Mmax) for some of the major faults in the area (determined by the map modified from "Caltrans Deterministic PGA Map, September 2007".) are summarized in Table 1 below. These maximum credible earthquake magnitudes represent the largest earthquakes that could occur on the given fault based on the current understanding of the regional tectonic structure.

TABLE 1: EARTHQUAKE DATA

Fault	Estimated Distance from Project Site	Maximum Credible Earthquake
Cascade Fault	1.8 miles	6.9
San Andreas Fault Zone (Peninsula section)	4.2 miles	7.9
Monte Vista-Shannon Fault Zone	0.2 miles	6.7

Caltrans recently updated the 1996 Seismic Hazard map with the new Caltrans Deterministic PGA Map (2007) and the Caltrans ARS Online (V 1.0) design spectrum for the development of response spectrum for design. The new design methods incorporate both deterministic and probabilistic seismic hazards to produce the Design Response Spectrum.

Based on the new 2007 Caltrans Fault Data Set and the 2009 Caltrans Seismic Design Criteria (SDC), the ARS curve is governed by the 2008 USGS Deaggregation (Beta) method. The associated Peak Ground Acceleration (PGA) for the San Andreas Fault is anticipated to be 0.66 g. The recommended curve is based on the newly adopted criteria. The USGS Interactive Deaggregation Tool (Beta) results are used to compare with the ARS Online results. Since there is a discrepancy of more than 10% (for periods > 0.5 sec) identified between ARS Online results and the 2008 USGS Deaggregation Tool (Beta), the 2008 USGS Interactive Deaggregation Tool (Beta) results were used to generate the seismic curve presented in Plate 5.

8.2 Seismic Hazards

Potential seismic hazards may arise from three sources: surface fault rupture, ground shaking and liquefaction. Based on available geological and seismic data, the possibility of the site to experience strong ground shaking may be considered high.

No active faults pass through the project site; the potential for fault rupture is relatively low. The eastern trace of the Monte Vista Fault has been mapped as concealed and along the toe of the natural slope approximately 25 feet to 75 feet west of the planned excavation of the South Basin. The fault plane dips steeply towards the west (into the slope). The proposed excavation in the South Basin is not expected to expose the fault plane of Monte Vista Fault.

8.3 Liquefaction Potential

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and silts of low relative density are the type of soils, which usually are susceptible to liquefaction. Clays are generally not susceptible to liquefaction.

Based on the field logs and available data, the subsurface soils encountered during our investigation are generally intermittent layers of medium dense to dense sand/gravel and stiff to hard clay with pockets/lenses/layers of firm clay. Groundwater was generally encountered at the depths between 13 feet and 27 feet below existing ground surface in some of the soil borings as discussed in Section 7 “Subsurface Soil Conditions”.

The liquefaction potential of the sand deposits was analyzed based on Borings RS-B-6 through RS-B-8. The analyses were performed using the procedure developed by Seed and Idriss (1982) on the nearby San Andreas Fault with a magnitude of 7.9 Earthquake, resulting in a peak ground acceleration of about 0.66 g. This method compares the estimates of the earthquake-induced shear stress to the susceptibility of soil liquefaction.

The boring number, approximate depth, approximate thickness of the sand pockets/lenses, measured groundwater elevation and estimated post-liquefaction settlement are summarized in the Table 2 below.

TABLE 2: SUMMARY OF POST-LIQUEFACTION SETTLEMENT

Boring No.	Estimated Medium Dense Sand Depth (Approx. Thickness) (ft)	Estimated Medium Dense Sand Bottom Elev.(ft)	Measured Groundwater Elev. (ft)	Estimated Post-liquefaction Settlement (inches)
RS-B-6	8.0 (4.0)	413.9	398.8	0.3
RS-B-7	3.0 (4.0)	395.6	380.6	0.5
RS-B-8	3.0 (4.0)	391.5	385.0	0.4

Based on the results of the evaluation of liquefaction potential for the above soil borings, the estimated post-liquefaction settlements may be on the order of less than 0.5 inches.

However, it is our opinion that the liquefaction potential at the project site should be low since the medium dense sand pocket/lens is significantly above the measured groundwater level. These are the measurements in the monitoring well which has been measured for a period of over a year. It is unlikely that the liquefiable soil pocket/lens would be below the groundwater due to the seasonal fluctuation or other environmental factors.

In our opinion, the impact of the post-liquefaction settlement on the project should be relatively small because the medium dense sand exists in form of isolated pocket/lens at various elevations and the potentially liquefiable soil pocket/lens is covered by predominantly cohesive soils. These clay layers tend to serve as a “soil mat”. This should reduce any surface manifestation of the potential liquefaction.

In the event sand is exposed along the cut-slopes during the excavation of the basin and raveling or lateral spreading is a concern, the slopes can be confined with filter fabric and gabion or clay berm.

9. FINDINGS AND RECOMMENDATIONS

9.1 General

This report was prepared specifically for the proposed project. Normal construction procedures were assumed throughout our analyses and represent one of the bases of recommendations presented herein. Our design criteria have been based upon the materials and conditions encountered in the soil borings. Therefore, we should be notified in the event that these conditions are changed, so as to modify or amend our recommendations.

9.2 Earthwork and Grading

The project generally includes construction of the basin, access road, pipelines, a box culvert, and an extended parking lot. The project requires excavation for the basins. The maximum gradient of the proposed cut and fill slope, which is required for the grading work, should be 2(H): 1(V) or flatter.

Areas to receive engineered fill should be excavated to remove any loose/soft soil materials. Any existing pavement section should be removed and the pavement subgrade to be scarified. Areas receiving fill should be scarified, moisture conditioned and compacted in accordance with the project specifications. The resulting surface upon which fill is to be placed should be observed by the Geotechnical Engineer.

In general, engineered fill imported to the project site for the embankment and sliver fill should contain at least 40 percent of clay (by weight) passing US Standard Sieve No. 200 and should have Plasticity Index (PI) less than 15. The Liquid Limit of the fill material should also not exceed 40. In addition to the above requirements, the fill should not contain rocks or lumps over 3 inches in greatest dimension and should not contain more than 10 percent greater than 1 ½ inch. The on-site materials exposed after the excavation may be used for engineered fill provided that they meet the above criteria and are not contaminated.

The recommendations for required compaction as per ASTM D1557-91 are as follows:

- Minimum 90% for backfilling after removing trees, buried utilities and structures, depressions caused due to other construction activities, etc.
- Minimum 90% for subgrade receiving engineered fill.
- Minimum 90% for material below 6 inches of the foundation subgrade and below 18 inches of the flexible pavement subgrade.
- Minimum 95% for upper 6 inches of foundation subgrade and upper 18 inches of flexible pavement subgrade to reduce the potential for pavement failure.
- Minimum 95% for engineered fill under slabs-on-grade.

The engineered fill should be compacted in lifts that do not exceed 8 inches in loose thickness. The compaction moisture content of the fill material should be within the range of specified percentage dry and wet of laboratory optimum moisture content.

Fills to be placed on existing slope should be keyed and benched into the slope. The height of the key should not be less than 3 feet or more than 5 feet and the minimum width should be 6 feet. The frequency and location of the benches may be adjusted and modified in the field as necessary. We also recommend that the fill to be placed on the slopes should be over-built and cut back to the proposed grade. It is generally up to the contractor's construction method to meet this requirement. However, a minimum 2 feet of overbuilding can be specified to provide a compacted slope surface. Grading for both basins should be performed under the observation of the regulatory agency or Geotechnical Engineer in accordance with the project specifications.

9.3 Box Culvert

A 9.5-foot by 5-foot concrete box culvert will be constructed underneath the maintenance road. The total length of the box culvert will be approximately 52 feet.

Based on Boring RS-B-1 in the vicinity, the subsurface soil conditions at the footing subgrade of the proposed concrete culvert is anticipated to consist of soft to medium stiff sandy lean clay, underlain by hard sandy lean clay/lean clay. Groundwater was measured at approximate depth of 13 feet (approximate Elev. +424 feet) during drilling in August 2010. The invert (Elev. +431.0 feet) of the box culvert will have a 2% fall and will conform to approximately the existing creek invert of the Permanente Creek.

9.3.1 Static Lateral Earth Pressures

For the proposed box culvert, the design vertical and lateral earth pressure should conform to Section 6.21 of Caltrans Bridge Design Specifications (April 2000) (BDS). Per Caltrans BDS, the recommended unit weight of soil (vertical pressure) is 140 pcf. The recommended lateral earth pressures for design should include two design conditions, 35 pcf Equivalent Fluid Pressure (EFP) and 100 pcf EFP for Reinforced Concrete Box.

9.3.2 Foundation Design

Recommended allowable bearing capacity for the box culvert is 2.0 kip per square foot.

9.3.3 Foundation Subgrade Preparation

Based upon the measured groundwater elevation and subsurface soil conditions, a pad constructed of two feet thick aggregate base wrapped in subgrade enhancement geotextile underneath the proposed box culvert is recommended to facilitate construction and provide a uniform support. The proposed concrete culvert should be supported on a pad, which should be constructed as follows:

(a) Excavate approximately 2 feet of existing soil below the bottom of the box culvert. The excavation should extend 2 feet beyond the culvert footprint.

(b) Place a layer of subgrade enhancement geotextile on the subgrade. The subgrade enhancement geotextile should conform to Caltrans Standard Specification (Section 88-1.02O, Class B2).

(c) Place 2 feet of aggregate base over the subgrade enhancement geotextile. The aggregate base should be compacted to 95-percent relative compaction per ASTM D-1557.

(d) The subgrade enhancement geotextile should be wrapped on top of the compacted aggregate base for a minimum overlap of two feet.

9.4 Wing Walls, Control Structure, Pipe Connector and Silting Basin

The following structures are proposed in connection with the box culvert and drainage pipes etc.

TABLE 3: SUMMARY OF STRUCTURES

Structure	**Location**	**Purpose**	**Approximate Length**	**Approximate Footing Elev. (ft)**
Wing Wall	Upstream and downstream face of box culvert.	Diverts water to the box culvert.	14.0 feet – 20.0 feet	430.0
Control Structure	Immediately south of maintenance road.	Diverts water to the basins.	Minimum 157.0 feet	Not applicable
Pipe Connector	Between inlet pipe and the control structure.	Diverts water from the control structure to the inlet pipe.	Not applicable	Between 433.0 and 437.0
Silting Basin	Outlet of 84-inch CMP to North Basin	To remove silt and sand.	Not applicable	391.0

Except for the control structure, the other structures should be designed as conventional retaining walls supported on spread footings.

9.4.1 Lateral Earth Pressures and Design Parameters

Wing walls, control structures, pipe connectors and silting basin should be designed to resist the following applied lateral earth pressures (Equivalent Fluid Pressures) and design parameters.

(a) The recommended active pressure is 36 pcf EFP for the engineered fill.

(b) The recommended at-rest pressure is 55 pcf EFP for the engineered fill.

(c) The recommended passive resistance against the side of the wall footing is 330 pcf EFP.

(d) A coefficient of friction of 0.3 may be used to estimate the frictional resistance along the bottom of the footing. Only dead loads should be used to estimate the frictional resistance at the bottom of footings.

(e) Not more than 50% of the available passive lateral earth pressures shall be considered in determining the factor of safety against sliding.

(f) The effect of any surcharge (dead or live load) should be added to the preceding lateral earth pressures. Use equivalent earth pressure of not less than 2 feet of uniform soil weight at 125 pcf if the traffic (HS20 loading) is within a horizontal distance of one half of the wall height.

Cantilever walls, which are free to rotate by at least 0.01 radian, may be assumed flexible and designed for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. A coefficient of 0.4 and 0.5 may be used to determine the additional lateral earth pressures resulting from the surcharge for cantilever walls and rigid walls, respectively.

The above values assume no hydrostatic pore pressure build up behind the wall and are based on well-drained backfill behind the walls. A minimum 1-foot thick compact clay cover or concrete cap should be placed over the well-drained material. If hydrostatic pressures are allowed to build up behind the walls, additional lateral loads should be considered in the design.

9.4.2 Foundation Design

Recommended allowable bearing capacity for the wing walls, pipe connectors and silting basin is 2.0 kip per square foot.

If soft soil material is encountered at the foundation subgrade of the wing walls, pipe connectors or silting basin, "pumping" or yielding to the required equipment operations may occur. This creates mobility problem for the equipments and prevents it from performing the required work. Foundation subgrade preparation similar to the box culvert as discussed in Section 9.3.3 should be considered to help mitigate these pumping issues.

9.5 Pipeline

According to the "60% Design" Plans, the pipelines proposed for this project, their sizes, locations and approximate invert elevations etc. are summarized in the Table 4 and Table 5 below.

TABLE 4: SUMMARY OF PIPELINE INFORMATION

Name	Size (inches)	Type of Pipe	Location	Length of Pipe (ft)	Approximate Invert Elev. (ft)
North Basin Outlet Pipe	24	Corrugated Metal Pipe	North Basin to Permanente Creek	234	394.00 – 392.50
South Basin Outlet Pipe	24	Corrugated Metal Pipe	South Basin to Permanente Creek	215	432.65 – 430.50
South Basin Inlet Pipe	36	Corrugated Metal Pipe	Control Structure to South Basin	28	438.0
North Basin Inlet Pipe	84	Corrugated Metal Pipe	Control Structure to North Basin	1,422	433.0 – 395.0

TABLE 5: SUMMARY OF SUBSURFACE SOIL CONDITIONS FOR PIPELINE

Name	**Approximate Invert Elev. (ft)**	**Reference Boring**	**Subgrade Subsurface Soil Conditions**	**Measured Groundwater Elev. (ft)**
North Basin Outlet Pipe	394.00 – 392.50	RS-B-7	Medium stiff lean clay with sand, underlain by medium dense clayey sand.	380.5
South Basin Outlet Pipe	432.65 – 430.50	RS-B-1	Soft to medium stiff sandy lean clay.	424.0
South Basin Inlet Pipe	438.0	RS-B-1	Medium stiff sandy silt with gravel.	424.0
North Basin Inlet Pipe	433.0 – 395.0	RS-B-2, RS-B-3 & RS-B-3(W)	Medium dense to very dense sand/gravel with occasional pockets/lenses of firm to very stiff lean clay.	395.0 - 397.0 [RS-B-3(W)]

“Open Cut and Cover” construction method will be used for the installation of the inlet pipes and outlet pipes. The trenching, bedding subgrade and subgrade preparation etc. will be discussed in the subsections below.

9.5.1 Trenching

Following are the guideline recommendations that have been incorporated from the specifications used by the SCVWD on previous projects.

The bottom of the trench shall be a minimum of 8 inches wider than the outer diameter of the pipe. The depth of trench shall be at least the minimum depth of cover (36" for water pipeline) plus 6" for pipe bedding plus the outer diameter of the pipe. The Contractor shall support all existing utilities within the excavation or trench as required to avoid damage to the existing utilities.

9.5.2 Bedding Subgrade

Based on available boring data, the subsurface soil conditions anticipated at the planned pipe invert depth generally consist of soft to medium stiff lean clay/silt or medium dense to very dense sand/gravel with occasional pockets/lenses of firm to very stiff lean clay. Groundwater was measured between approximate Elev. +380.5 feet and +424.0 feet during drilling. Based on the subsurface soils encountered in the investigation and assuming that proper dewatering (if necessary) and construction procedures are used, the foundation soils should generally be capable of supporting the pipelines at the planned pipe invert depths.

9.5.3 Subgrade Preparation

The subgrade should be prepared to provide uniform bearing throughout the entire length of the pipe conduits. Subgrade shall be smooth, uniform, and free of debris, sharp rocks, etc. before adding the pipe bedding. Where hard unyielding materials larger than 3 inches, such as gravels, cobbles, etc., which may cause local stresses in the pipeline, are encountered in the trench bottom, they should be excavated out and backfilled with bedding material or they should be bridged with at least 6 inches of bedding material.

Generally, the materials anticipated at the pipeline invert elevations consist primarily of soft to medium stiff lean clay/silt or medium dense to very dense sand/gravel with occasional pockets/lenses of firm to very stiff lean clay as indicated from the field exploration. In the event local soft/wet conditions are encountered, it may be necessary to stabilize the subgrade prior to placing pipe bedding (foundation for the pipeline). Stabilization can be accomplished by over-excavating the subgrade and replacing with a working platform. The platform could be constructed as follows:

(a) The minimum depth of over-excavation should be 1 foot. A layer of high strength geofabric (Mirafi 600X or equivalent) should be placed over the over-excavated subgrade;

(b) Minimum 1 foot of Class 2 Permeable 3/4-inch crushed rock should be placed. The ends of the filter fabric should then be overlapped on top of the Class 2 Permeable 3/4-inch crushed rock for a minimum distance of 2 feet.

The imported crushed rock and sources should be approved by the Engineer or the Agency prior to importing and placing the materials on the project site. The top of the working platform may be densified by vibratory compaction equipment prior to placing the pipe bedding. The Contractor's method of compacting the working platform should be reviewed by the Engineer. The Contractor may use other methods of subgrade stabilization. The Contractor's proposed method should be reviewed by the Engineer.

The actual locations and quantity of the over-excavations/backfill placement may vary depending on the subsurface soil conditions in the field. The Geotechnical Engineer should review the over-excavations during construction. It may be prudent to have these available on a unit rate or contingency basis. If shoring is used during construction, it should be designed to accommodate the above discussed over-excavation depth.

9.5.4 Pipe Bedding

The bedding material details should conform to the SCVWD standards, which consists either "select backfill" or "Controlled Density Fill".

Select Backfill

The "Select Backfill" shall be according to SCVWD specifications. The pipe bedding should consist of imported, well-graded, granular material. The select backfill shall conform to the following gradation:

Sieve Size	Percent Passing by Weight
3/4-inch	100
No. 4	25 – 90
No. 200	0 – 12

Select backfill shall conform to the following requirements.

California Test Method	Individual Test Result	Moving Average
Sand Equivalent (217)	28 Minimum	31 Min.
Resistance (R-value) (301)	78 Minimum	50 Min.

If Sand Equivalent exceeds 35, the R-value requirement shall be waived.

The thickness of bedding material should be minimum 6 inches below the pipe to the top of the pipeline. The Contractor should limit both method and equipment so as not to damage the integrity of the pipe or related facilities or induce a diametrical variation of greater than plus or minus 0.5%.

The placement, extent and relevant details of the bedding material should conform to the SCVWD design standards. The maximum loose thickness of each layer of select backfill material shall not exceed 8 inches if mechanically compacted, 4 inches if hand compacted. The Contractor may choose any method, which will compact the material to the requirements, as stated above, subject to the approval of the Engineer. The pipe shall be installed in a manner, which assures arc contact rather than line contact between pipe and compacted selected backfill. Select backfill material placed above the bottom of the pipe shall be placed simultaneously on both sides of the pipe. A minimum 95% relative compaction is recommended for the bedding. It is recommended that the degree of compaction be established based on density determined in accordance with ASTM Standard Test Method D1557.

Controlled Density Fill (CDF)

As an alternative to select backfill for bedding, the pipeline may be bedded on Controlled Density Fill. CDF is a self-compacting cementitious material, which consists of cement, fly ash, water, coarse and fine aggregates and admixture.

The following is the specification for CDF as pipe bedding:

CDF mix shall be composed of a cementitious material, water, fine and coarse aggregate, and an air entraining admixture meeting the following performance requirements: total calculated air content: maximum 10 percent, compressive strength: between 50 psi and 150 psi, wet density: less than 130 pounds per cubic foot.

Cement shall be Type II low alkali Portland cement conforming to ASTM C150.

Fly ash shall be class F conforming to ASTM C618 and shall not contain more than 3% carbon.

Fine aggregate shall be concrete sand, but needs not conform to ASTM C33, shall have no plastic fines and no more than 12 percent of aggregate passing a No. 200 sieve. Coarse aggregate shall be pea gravel no larger than 3/8 inch.

Water used for CDF shall be free from oils, salts, and other impurities, which would have an adverse effect on the quality of the CDF

Air entraining admixture shall conform to ASTM C 260.

A suggested mix design is as follows:

Material	**Weight**	**Specific Gravity**	**Absolute Volume Cubic Foot**
Cement	30 pounds	3.15	0.15
Fly Ash	300 pounds	2.30	2.09
Water	283 Pounds	1.00	4.54
Coarse Aggregate	1,465 pounds	2.68	8.76
Fine Aggregate	1,465 pounds	2.68	8.76
Admixture	4-6 ounces	-	2.70
TOTAL	3,543 pounds	-	27.00

The bedding material (except CDF) will be generally more permeable than the surrounding native soils and may provide a conduit for the flow of groundwater. This may result in soil migration from the surrounding area into the bedding material. If it is desired to minimize this flow, it is our opinion that cut-off dams be placed along the pipeline at frequent intervals. It is recommended to control the flow of water and the soil material by (a) installing cut-off dams and (b) wrapping the bedding with geofabric filter material.

(a) Cut-off dams should be installed at periodic intervals in order to limit groundwater flow. The spacing of the cut-off dams is a function of the accepted risk. At a minimum, we recommend spacing of 250 feet. Cut-off dams could consist of compacted native clay soils, concrete, soil-cement or CDF. The soil-cement and CDF used for cut-off dams should be designed for a permeability not to exceed 10^{-2} ft/year (or 10^{-7} cm/sec).

(b) The bedding should be wrapped by geofabric filter material (Mirafi 140N or equivalent). The geofabric filter material should be extended on all three sides and should have the manufacturer's recommended overlap on the top. Minimum 2 feet of overlap is recommended.

9.5.5 Trench Backfill

The discussions of backfill material are relative to the SCVWD's standard details and include Type "A" backfill and Type "B" backfill.

Type "A" Backfill

According to the specifications by SCVWD, Type "A" backfill may, at the Contractor's option, be either select backfill material or material from trench excavation or structure excavations from which all vegetation, portland cement concrete, asphaltic concrete, or other debris have been removed. For material from trench or structure excavation, the material larger than ¾-inch shall not exceed 20 percent by volume and all material larger than 1½-inch shall be removed. Backfill material above the bedding should be Type "A" backfill per the SCVWD's standard design and should be a minimum of 12 inch over the top of the pipeline.

Based on the boring data, the soils within the proposed trench excavation may be sand with gravel and may not meet the SCVWD's specifications. The native clay soils from the excavation are likely to meet the SCVWD's specifications and could be used as Type "A" backfill. However, due to the generally high moisture content of the native clay soils, the materials could require considerable reworking and aeration in order to achieve the required compaction criteria. Saturated soils should not be placed as backfill until they are dried and processed to be within the specified percent of the laboratory optimum moisture content in order to achieve the recommended relative compaction. Backfill not meeting the compaction requirement, particularly in close proximity of the top of the pipe and bedding, could induce excessive vertical and lateral deflection of flexible pipes.

Alternatively, Type “A” backfill could be imported select material free from organic matter or other deleterious substances. The imported select material should be relatively granular and have a minimum R-value of 15 and a minimum Sand Equivalent of 20. The imported material should be reviewed by the Engineer prior to importing and placement.

Type “A” backfill material shall be compacted in accordance with the applicable provisions of SCVWD’s specifications and to the following:

- Within existing paved areas, sidewalks, curb and gutters, driveways, or shoulders, and within 5 horizontal feet of existing utilities, the relative compaction shall be not less than 90%.
- Within 1-foot of the walls of all structures and related facilities, the relative compaction shall be not less than 95%.
- In all other areas, the relative compaction shall be not less than 85%.

The loose thickness of each layer of Type “A” backfill material shall not exceed 8 inches, if mechanically compacted, or 4 inches, if hand compacted and shall be placed simultaneously on both sides of the pipe. The percent relative compaction shall be determined and controlled in accordance with the ASTM Standard Test Method D1557. The placement, extent and relevant details of the Type “A” backfill should conform to the SCVWD design standards. Field and laboratory testing of backfill materials should be performed to determine whether applicable requirements have been met.

The backfill materials should be placed by methods that do not disturb or damage the pipes. Within the pipe zone, heavy equipment operating over the pipe could result in damage, excessive deflections or other disturbances to the pipe where soil cover is insufficient. A minimum soil cover of 3 feet should be placed over the crown of the pipe prior to the use of heavy equipment. Type "A" backfill below this level should be carefully compacted with relatively light compaction equipment to avoid overstress on the pipe.

Type "B" Backfill

Type "B" backfill material shall be clean uniformly graded material from which all vegetation, Portland cement concrete, asphaltic concrete, other debris has been removed. This material, which will provide a cap over the Type "A" backfill for the trench in the unpaved areas. Type "B" backfill shall have a permeability less than or equal to the native material adjacent to the trench. No particles larger than 6 inches will be allowed. Material from trench excavation or structure excavation that satisfies these requirements may be used for Type "B" backfill. Similar to the Type "A" backfill above, the native excavated clay or clayey sand may require considerable reworking and aeration before they can be compacted to meet the specification requirements. Therefore, as an alternative, imported earthfill material could be used for Type "B" Backfill.

Type "B" backfill material shall be placed in loose layers not exceeding a thickness of 8 inches. Jetting will not be allowed. Type "B" backfill material shall not be placed within 1-foot of the walls of any structures or in areas where pavement, sidewalk, curb and gutter, or shoulders are required to be removed and replaced. Type "B" backfill material shall be compacted to a relative compaction of not less than 85% per ASTM Standard Test Method D1557 in the non-paved areas.

Since the native soils materials are generally clay or clayey sand, the pipe bedding and the trench backfill (Type “A” and/or Type “B”) are recommended to be wrapped around by filter fabric to prevent the migration of fines from the native soil materials to the pipe bedding and the trench backfill. The geosynthetics used for filter fabric must be permeable and nonwoven and should conform to Caltrans Standard Specification (Section 88-1.02B).

CDF

CDF can also be considered as an alternative to Type “A” and Type “B” backfill as described above. The advantage of CDF over the regular backfill for this project is

- Easy to place
- Fills in irregularities
- Homogenous fill
- No compaction needed
- Once it set up, it should not settle
- Safety of workers
- Save time and cost

CDF has been widely used by public agencies for deep trench backfill applications. The SCVWD specification for CDF is included in Section 9.5.4 above.

A warning tape is required to be furnished and installed within the Type “A” backfill material (trench in the paved areas) or the Type “B” backfill material (trench in the unpaved areas) by the Contractor.

9.5.6 Pipe Friction and Thrust Block Design

At locations where the pipeline changes direction, dead ends or develops thrusts at valves or other attachments, the tendency of movements can be resisted by (a) friction between the pipe and surrounding backfill, and (b) thrust blocks. A coefficient of 0.30 can be used to determine the friction between the pipe and the backfill. A total unit weight of 125 pcf and a submerged unit weight of 63 pcf (for soils below groundwater level) may be used to calculate the frictional forces between the pipes and the bedding material. Thrust blocks can be designed for the lateral earth pressures as described in Section 9.4.1.

Thrust blocks should be at least 12 inches wide and should be founded at least 12 inches below the pipe invert. In sizing the thrust blocks for design, it should be noted that the maximum toe pressures of the thrust block should not exceed the allowable bearing capacity of 2,000 psf under submerged condition. The thrust blocks should be poured neat against relatively undisturbed native soils.

9.5.7 Buoyancy of Pipes

Based on the present design; the groundwater level encountered in the field explorations; and potential for high storm water level at Permanente Creek, the proposed pipelines will be subject to submerged or partially submerged conditions. Buoyancy should be considered for the design.

Groundwater was recorded at approximate depths between 13.5 feet and 27 feet below existing ground surface (between approximate Elevation +380 feet and +400 feet) in Borings RS-B-3(W), RS-B-4(W), RS-B-6 through RS-B-8 and approximate depth of 13 feet below existing ground surface (approximate Elevation +424 feet) in Boring RS-B-1 during drilling in August 2010 and June 2011. Maximum groundwater level was measured to approximate Elevation +406 feet in the monitoring well installed in Boring RS-B-4(W) and approximate Elevation +395 feet in the monitoring well installed in Boring RS-B-3(W). The groundwater level at the site is anticipated to vary with the passage of time due to seasonal groundwater fluctuation, surface and subsurface flows, ground surface run-off, change in the water level in the nearby Permanente Creek, and other factors which may not have been present at the time of the investigation.

9.6 Slope Stability Evaluation

The project site will include excavation, placement of fill for the berm of the North Basin and South Basin and placement of sliver fill for the maintenance road.

The topography and aerial photos of the hillside west of the proposed South Basin is suggestive of past landslide activity. The concave arcuate contours indicate a broad landslide source area. The cut slope planned on the western side of the South Basin may cut into the toe of the landslide deposits and could destabilize what appear to be the dormant landslide deposits. If the inferred landslides have transported near-surface fault planes of the Monte-Vista Fault downhill (to the east), fault-sheared materials may be exposed by the planned excavation. The "Inferred Landslide Sources and Toes", Plate No. 3A with the inferred downhill extent of the landslide deposit indicated by a dashed red line and the uphill extent of the inferred landslide source area indicated by a solid yellow line. Therefore, the cut slope proposed on the west side of the South Basin is not recommended and the excavation plan should be revised to minimize the extent of excavation into the Monte-Vista Fault portion of the slope. Detail study of this landslide deposits is not in the scope of this work. Based on the available topography, a minimum excavation setback distance of 25 feet from the apparent toe of the slope is recommended.

The global stability of the slope formed at the South Basin, North Basin and access road to the cemetery was evaluated under the static condition and pseudo-static condition. Slope stability analyses were performed using Slope/W 2007 Program by Geo-Slope International. Critical sections used for the slope stability analyses were developed based on the proposed slope geometries, geology and boring logs.

a) The effective and total strength parameters were based on field exploration and laboratory strength tests performed by PARIKH in 2011, empirical correlation and engineering judgment. The field and laboratory test data include standard penetration tests and strength tests. The assumed effective strength parameters of cohesive soil, apparent cohesion c' are generally between 100 psf and 500 psf as recommended by Lamb and Whitman.

b) A surcharge load of 250 psf was assumed for the maintenance vehicle and construction equipments and/or construction materials.

c) Earthquake loading conditions were modeled by using a seismic loading coefficient for pseudo-static analysis. Per Caltrans "Guidelines for Foundation Investigations and Reports", pseudo-static analyses may be performed using a seismic coefficient equal to one third of the horizontal peak ground acceleration and not exceeding 0.2 g.

d) A minimum factor of safety of 1.5 is required for the static condition and 1.1 is required for the pseudo-static condition.

The location of the slope, approximate maximum slope height, slope gradient and factors of safety obtained from the slope stability analyses are summarized in Table 6.

TABLE 6: SLOPE STABILITY ANALYSES - SUMMARY OF FACTOR OF SAFETY

Location	**Section No.**	**Cut/Fill Slope**	**Approximate Max Slope Height (ft)**	**Approx. Slope Gradient**	**Minimum Factor of Safety**	
					Static Condition	**Seismic Condition**
South Basin	2-2	Fill Slope	11	2(H): 1(V)	1.8	1.2
North Basin	3-3	Cut Slope	32	3.5(H): 1(V)	2.3	1.3
North Basin	4-4	Fill Slope	9	4(H): 1(V)	2.9	1.6
Access Road	5-5	Sliver Fill	13	2(H): 1(V)	1.7	1.1

Note: (1) Section 1-1 is not used.
(2) Location of Sections 2-2 through 4-4 are shown on the "Site Plan", Plate No. 2

Based on the results of the stability analyses, the stability of the proposed slope formation at the South Basin, North Basin and access road has the adequate global stability under static and seismic (pseudo-static) loading conditions.

The stability analysis evaluates the overall global slope stability. After the excavation, strength softening is expected for the bare (before the application of surface protection) surficial cohesive soil materials submerged under water. Stiff clays tend to be fissured to some degree. The unconfined clays at the face of the cut may be cyclically dried and wetted and the fissures will tend to open. The fissures will be filled with water as the water level rises and local sloughing and cracking etc. may occur after the water recedes. Exposed pockets of cohesionless sand or silt on the face of the cut slope could also experience minor slough during construction. Therefore, the construction for the slope formation should be planned in the dry season with the minimum water level in the basin. Adequate surface protection should be provided to the slope surface after its exposure during construction. Regular routine maintenance should be carried out in the future to ensure proper surface protection to the slope.

9.7 Corrosion

Chemical tests were performed on soil samples from Borings RS-B-3 and RS-B-8 to evaluate the corrosion potential of the subsoil. The test results are as follows:

TABLE 7 SUMMARY OF CORROSION TEST RESULT

Boring	Depth (feet)	Minimum Resistivity (ohms-cm)	PH	Water-soluble Chloride (ppm)	Water-soluble Sulfate (ppm)
RS-B-3	10.0	2950	7.50	17.5	1.4
RS-B-8	9.5	1050	7.23	13.8	42.7

Based on the laboratory test data and Caltrans guidelines, the native soils on-site are considered non-corrosive.

9.8 Structural Pavement Design

R-value tests were performed on the representative bulk soil samples obtained at the locations of Borings RS-B-7 and RS-B-8 for the structural pavement design of the future extended parking lot and access road. Based on the R-value test results, R-values of 18 and 19 were obtained for the subgrade soils. An R-value of 15 is selected for on-site basement soil in the structural pavement design.

The recommended minimum R-value for Class 2 Aggregate Base (AB) is 78. Import "Fill Material" placed within 4 feet of the finish pavement subgrade should be free of organic or other deleterious materials and have a minimum R-value of 15. A Traffic Index (T.I.) of 5 was provided by the designer. Based on the Caltrans Highway Design Manual Section 608, the following are the recommended structural pavement sections:

0.35 feet Hot Mixed Asphalt (HMA) (Type A)
0.70 feet Aggregate Base (AB) (Class 2)

0.35 feet Hot Mixed Asphalt (HMA) (Type A)
0.35 feet Aggregate Base (AB) (Class 2)
0.35 feet Aggregate Subbase (AS) (Class 4)

Or 0.60 feet Hot Mixed Asphalt (HMA) (Type A)

Aggregate Base: Aggregate Base (Class 2) shall conform to the provisions in Section 26 of the Caltrans Standard Specifications, 2010.

Aggregate Subbase: Aggregate Subbase (Class 4) shall conform to the provisions in Section 25 of the Caltrans Standard Specifications, 2010 and to the Special Provisions.

Aggregate Subbase (Class 4) shall be clean and free from organic matter and other deleterious substances. The percentage composition by weight of Class 4 aggregate subbase shall conform to the following gradation as determined by California Test Method No. 202.

Gradation Requirement (Percent Passing)

Sieve Sizes	Operating Range	Contract Compliance
2 1/2 "	100	100
No. 4	30 – 65	25 – 70
No. 200	0 – 15	0 – 18

Aggregate Subbase (Class 4) shall also conform to the quality requirements given on the following table:

Quality Requirements

California Test Method	Operating Range	Contract Compliance
Sand Equivalent (217)	21 Min.	18 Min.
Resistance (R-value) (301)	50	50 Min.

9.9 Permeability Estimates for Swales

According to the designer, estimation of the infiltration rate is required for the existing ground near the South Basin and the proposed parking lot for the design of the storm water Best Management Practices.

No investigation of the in-situ infiltration rate was performed according to our scope of work for this project. Coefficient of permeability is estimated based on the soil type. Based on the available boring information in the vicinity of proposed parking lot and South Basin, the subsurface soil generally consists of clayey sand/silty sand (SC/SM) at the proposed parking lot (Boring RS-B-8) and sandy lean clay/lean clay (CL) at the South Basin (Borings RS-B-9 and RS-B-10).

Empirical correlation between the coefficient of permeability and soil type prepared by A. Casagrande, 1938 was used to estimate the order of magnitude of the coefficient of permeability of the native soil materials. Based on the results of the sieve analyses, the percentage of fine was found to be approximately between 10% and 35% for the clayey sand. Based on the percentage of fine content, the sandy lean clay can be classified as borderline between "very fine sands, organic and inorganic silts, mixtures of sand, silt, and clay etc." and "impervious" soils e.g. homogenous clays." with practically imperious and estimated coefficient of permeability of approximately 3.3×10^{-9} feet/sec. The clayey sand/silty sand can be classified as "very fine sands, organic and inorganic silts, mixtures of sand, silt, and clay etc." with practically poor drainage and estimated coefficient of permeability of approximately 3.3×10^{-7} feet/sec. These estimates are based on the particle size of the soil materials. Further variation in permeability can occur due to ground variation. According to Table B-3 of the "Caltrans Storm Water Quality Handbooks – Project Planning and Design Guide (May 2007)", the typical infiltration rate is 1 inch/hour for SC/SM and <0.05 inch/hour for

CL. The estimated coefficient of permeability is for reference only since it is based on the limited boring information in the vicinity of the proposed parking lot and South Basin.

10. CONSTRUCTION CONSIDERATIONS

Prospective contractors for the project must evaluate construction-related issues on the basis of their own knowledge and experience in the local area, on the basis of similar projects in other localities, or on the basis of field investigation on the site performed by them (if necessary), taking into account their own proposed construction methods and procedures.

10.1 Temporary Excavations Slope and Shoring

It is possible that unknown old buried utilities or abandoned structures, concrete rubble etc. might be encountered during excavations. This might require special equipment and additional efforts to remove these buried objects or obstructions.

The materials to be excavated are anticipated to be mostly firm to stiff clays and some medium dense sands. Excavations should not be expected to stand vertically without any support. According to OSHA Safety Standards, temporary excavations with personnel working within the excavations should be sloped or shored if the excavations are deeper than 5 feet.

All excavations should be closely monitored during excavation/construction to detect any evidence of instability, soil creep, settlements, etc. Appropriate mitigation measures and a comprehensive monitoring plan should be implemented to correct such situations that may cause or lead to future damage to facilities, utilities and other improvements.

Groundwater should be expected during excavation. A properly designed and constructed dewatering operation is recommended irrespective of the construction method used. The groundwater should be maintained at least 3 feet below the bottom of the excavation at all times. The issues related to “dewatering” are described in Section 10.4 below.

Operation of construction equipment and the resulting vibrations will adversely affect the native soils and other buildings/improvements at the site. Load from heavy equipment should be spread out using timber blocks or other appropriate measures. This should be taken into consideration in the evaluation of temporary slope stability and shoring system.

10.1.1 Temporary Excavation Slope

The slope height, inclination, and excavation depths should not exceed those specified in local, state, or federal safety regulations. The design of the temporary slopes by the contractor or his specialty subcontractor should conform to the OSHA's "Guidelines for Excavations and Temporary Sloping". The contractor/subcontractor should develop or modify their design based on the subsurface conditions exposed at the time of construction.

For excavations up to 20 feet deep in homogenous soils, OSHA guidelines state that the maximum allowable slope should be 3/4H: 1V, 1H:1V and 1-1/2H:1V for Types A, B and C soil, respectively (In general, Type A soils are stronger; Type B soils are intermediate, and Type C soils are weaker). Based on our evaluation of the materials encountered in our borings and the borings previously performed by others, in general the native soil on site should be considered as OSHA Type C. It should be noted that the slope ratios recommended by OSHA are for temporary, un-surcharged slopes. Traffic and surcharge loads should be set back at least 15 feet from the top of the excavations unless they are accounted for in the design. The temporary cut slopes discussed above assume that the groundwater is maintained below the bottom of the excavation at all times during construction. At a minimum, the groundwater should be maintained at least 3 feet below the bottom of the excavation at all times. Slopes may need to be flattened based on site specific condition and materials exposed during construction.

During our investigation, several sand pockets/lenses and layers were encountered at various locations and depths. Surficial drying of these granular soils and strength softening will result in sloughing and erosion if the bare surficial soil materials are exposed to weather and rain for extended periods of time. Stiff clays also tend to develop soil creep due to seasonal change in moisture content resulting in sloughing. To minimize sloughing and erosion of these soils, construction should be planned in the dry season. Appropriate mitigation measures should be implemented to protect the soils from sloughing and/or erosion if construction through the winter season is unavoidable. Adequate surface protection should be provided to protect the slope surface from excessive drying and/or saturation during construction and the exposed slopes should be kept moist (but not saturated) by occasional light spraying of water during construction.

10.1.2 Selection of Shoring System

Temporary shoring may be necessary for the support of proposed excavations for the pipelines construction. The selection, design and performance of the temporary shoring system should be the responsibility of the contractor. The contractor should have the shoring system designed and signed by a Registered Engineer. The contractor should evaluate the conditions and select appropriate construction methods.

The shoring system should be designed to be watertight, relatively rigid and with as many supports or struts as necessary to prevent excessive straining and deformation of the supported soils. This is also important with regard to existing surface improvements and existing utilities where tension cracking or movement may develop, even under minor strains.

Local hard driving conditions will be anticipated for the installation of temporary shoring such as sheet pile. Excessive noise and vibration from the hard driving will cause disturbance to the nearby residents and existing structures.

10.2 Excavation Bottom Stability

Due to fluctuation in groundwater elevation, excavation bottom instability during the excavation for the pipelines, pipe connectors and silting basin etc. may occur as a result of bottom heave, piping, or blow-out. If excavation bottom failure due to bottom heave, piping or blow-out occurs, measures such as trimie seal course, dewatering, installing deep sheeting, continuous inter-locking sheet piles, deep soil mix walls etc. will be required to mitigate these conditions. It is recommended that supplemental funds be provided for such mitigation measure(s).

10.3 Working Mobility

Groundwater should be expected during excavations. If the subgrade soils are sufficiently disturbed due to construction activities and/or are saturated, they could become soft or loose. In such case, working conditions at the bottom of excavation may become difficult and equipment used at the bottom of the excavations may loose mobility, etc. The contractor should take adequate measures to minimize the disturbance of the sensitive deposit at the excavation subgrade.

The Contractor may minimize the disturbance of sensitive deposits or mitigate existing soft ground conditions by constructing a “foundation pad” as discussed in Section 9.3.3. The Contractor may use other methods of subgrade stabilization, which should be reviewed by the Geotechnical Engineer.

10.4 Dewatering

“Dewatering” shall mean any operation or system required to lower the groundwater level for construction. Dewatering of excavations is normally the responsibility of the contractor. As described in the Section 6 "Subsurface Soil Conditions", groundwater at the site was encountered at the depths between 13.5 feet (approximate Elev. +424 feet) in Boring RS-B-1 and 22 feet (approximate Elev. +380.5 feet) in Boring RS-B-7 at the time of drilling. Maximum groundwater level was measured to approximate Elevation +406 feet in the monitoring well installed in Boring RS-B-4(W) and approximate Elevation

+395 feet in the monitoring well installed in Boring RS-B-3(W). Major excavation will be required at a) the North Basin (approximate bottom of excavation ≈ Elev. +394 feet); b) North Basin Inlet Pipe from the Control Structure to North Basin (Invert Elev. approximately from Elev. + 433 feet to Elev. +395 feet); c) North Basin Outlet Pipe from North Basin to Permanente Creek (Invert Elev. approximately from Elev. + 394 feet to Elev. +392.5 feet); d) South Basin Inlet Pipe from South Basin to Permanente Creek (Invert Elev. approximately from Elev. + 432.65 feet to Elev. +390.5 feet).

Groundwater should be anticipated during excavations. Generally, in such case groundwater will cause instability of the excavation bottom (blow-outs, piping, pumping etc.) and also result in difficult working conditions at the excavation bottom. Unstable excavation bottom may cause slope failures, damage the shoring system, etc. Excessive water in the excavations also results in difficult working conditions at the bottom of the excavations causing subsequent delays in work and/or additional efforts during construction.

The Contractor should implement a dewatering system to mitigate these conditions. All dewatering schemes proposed by the Contractor should be submitted by the Contractor prior to implementation. However, developing and implementing an effective dewatering program should be the Contractor's responsibility. A properly designed and constructed dewatering operation is recommended irrespective of the construction method used. This may include, but not limited to, sump pumps, well-points, continuous inter-locking sheet piles, deep soil mix walls or other appropriate methods. The groundwater should be maintained at a reasonable depth below the bottom of the excavation at all times to achieve a workable condition.

All dewatering systems should be properly designed to prevent pumping soil fines with the discharge water. The Contractor should sample and test the groundwater for soil fines content from the wells, as needed. If soil fines are being pumped, the Contractor should revise his dewatering operations; otherwise, failure of shoring, partial instability of excavation bottom resulting in intolerable settlement/movement of foundations of existing structures and utilities and unsafe working conditions might occur. The contractor should provide discharged sampling locations for each pump. In addition, dewatering should not be performed at an excessive rate that could disturb the groundwater regime and draw water that may be contaminated.

Contractor should evaluate the site conditions and perform their own investigation, test program, etc. prior to construction in order to satisfy their design requirements for an effective program.

11. PLAN REVIEW

This report is prepared for the proposed "Permanente Creek Flood Protection Project - Rancho San Antonio Basin". We recommend that final plans for the proposed project to be reviewed by PARIKH prior to construction so that the intent of our recommendations is included in the project plans and specifications and to further see that no misunderstandings or misinterpretations have occurred. However, design-build elements should be reviewed only from overall compliance standpoint.

12. CONSTRUCTION OBSERVATION

To a degree, the performance of any structure is dependent upon construction procedures and quality control measures. Hence, geotechnical observation and testing of grading operations and foundation excavations should be carried out by the Geotechnical Engineer. If the subsurface conditions different from those forming the basis of our recommendations are encountered, PARIKH should be informed in order to assess the need for design changes. Therefore, the recommendations presented in this report are contingent upon good quality control and these geotechnical observations during construction.

13. INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our site reconnaissance and the assumption that the subsurface conditions do not deviate from observed conditions. All work done is in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings. The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site. Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; different soil conditions may require that additional expenditures be made during construction to attain a properly constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed project as described earlier, to assist the engineer in the design of this project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during construction, our conclusions and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field.

The findings in this report are valid as of the present date. However, changes in the subsurface conditions can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,
PARIKH CONSULTANTS, INC.

Alston Lam, P.E., G.E. 2605
Project Engineer

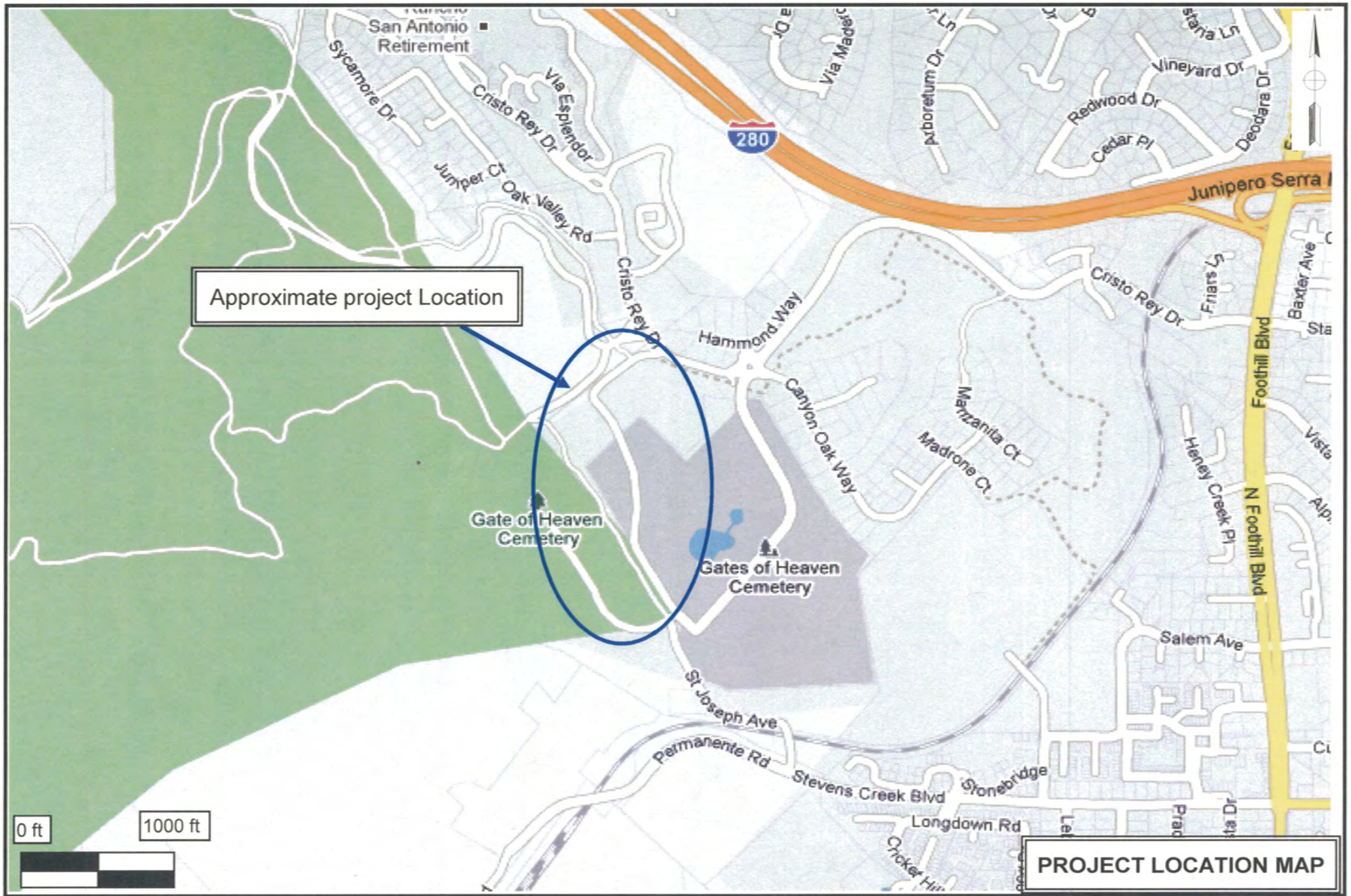
Gary Parikh, P.E., G.E. 666
Project Manager

REGISTERED PROFESSIONAL ENGINEER
GAURANG R. PARIKH
No. 666
EXP. 12-31-15
GEOTECHNICAL
STATE OF CALIFORNIA

S:\Ongoing\Alston Lam\2010-108-10\Permanente Creek Rancho San Antonio Basin Geotechnical Report.rpt

REFERENCES

1. California Department of Transportation, Highway Design Manual, fifth edition, July 2008.
2. Geologic Map titled "Quaternary Geology of Santa Clara Valley, Santa Clara, Alameda, and San Mateo Counties, California. A digital database by E.J. Helley, R.W. Graymer, G.A. Phelps, P.K. Showalter, and C.M. Wentworth, 1994".
3. Caltrans Department of Transportation, Caltrans Deterministic PGA Map, September 2007.
4. Caltrans Department of Transportation, Division of Engineering Services Geotechnical Services "Guidelines for Structures Foundation Report", Version 2, March 2006.
5. California Department of Transportation, 2010, Standard Specifications, Sections 1 through 95.
6. Caltrans Storm Water Quality Handbooks Project Planning and Design Guide Appendix B, May 2007.



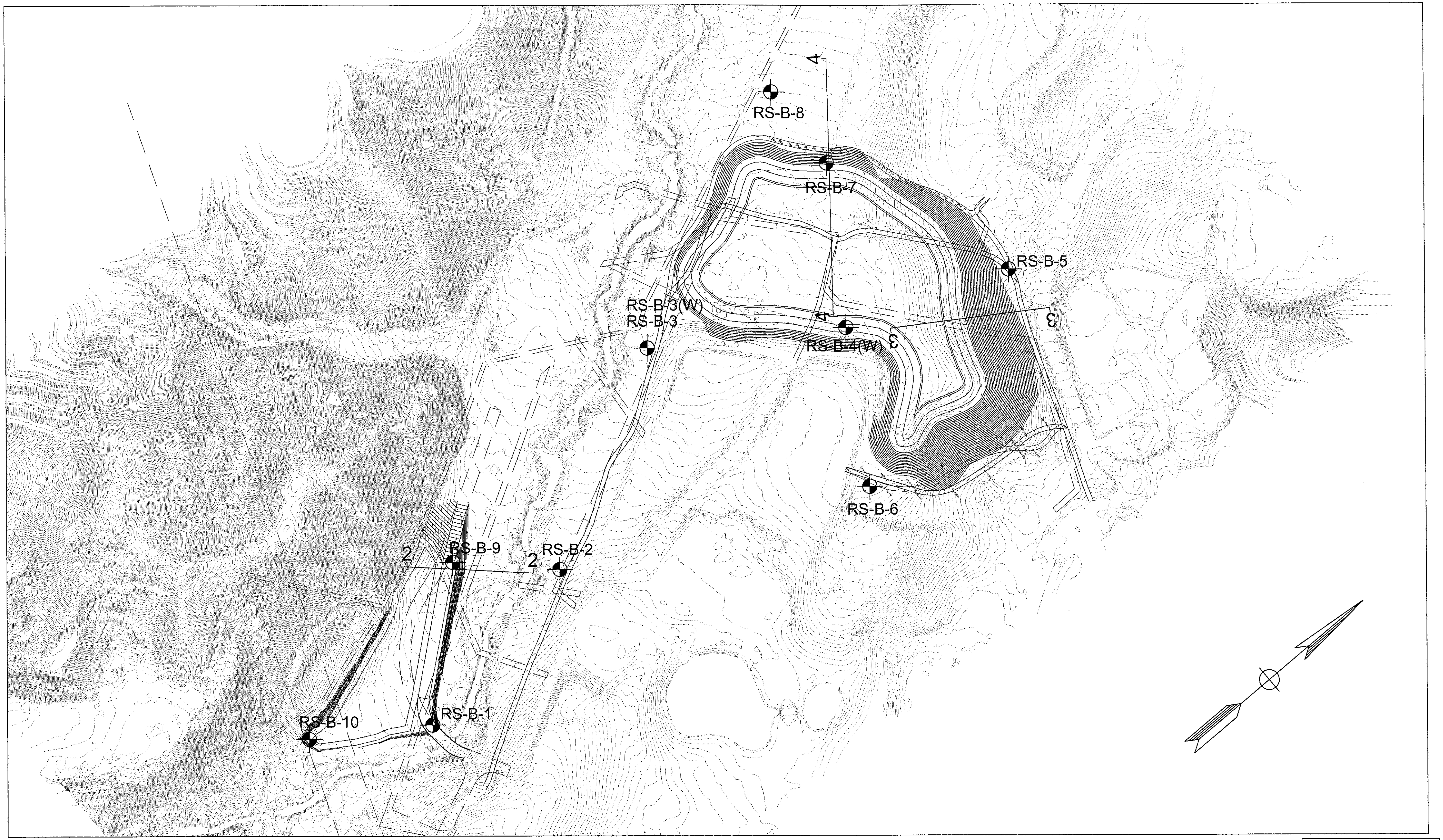
Approximate project Location

PROJECT LOCATION MAP

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

PERMANENTE CREEK FLOOD PROTECTION PROJECT - RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO.: 2010-108-RSA	**PLATE NO.: 1**



SITE PLAN

LEGEND
RS-B-1
⌖ Approx. Boring Location

SCALE 1 inch = 250 feet

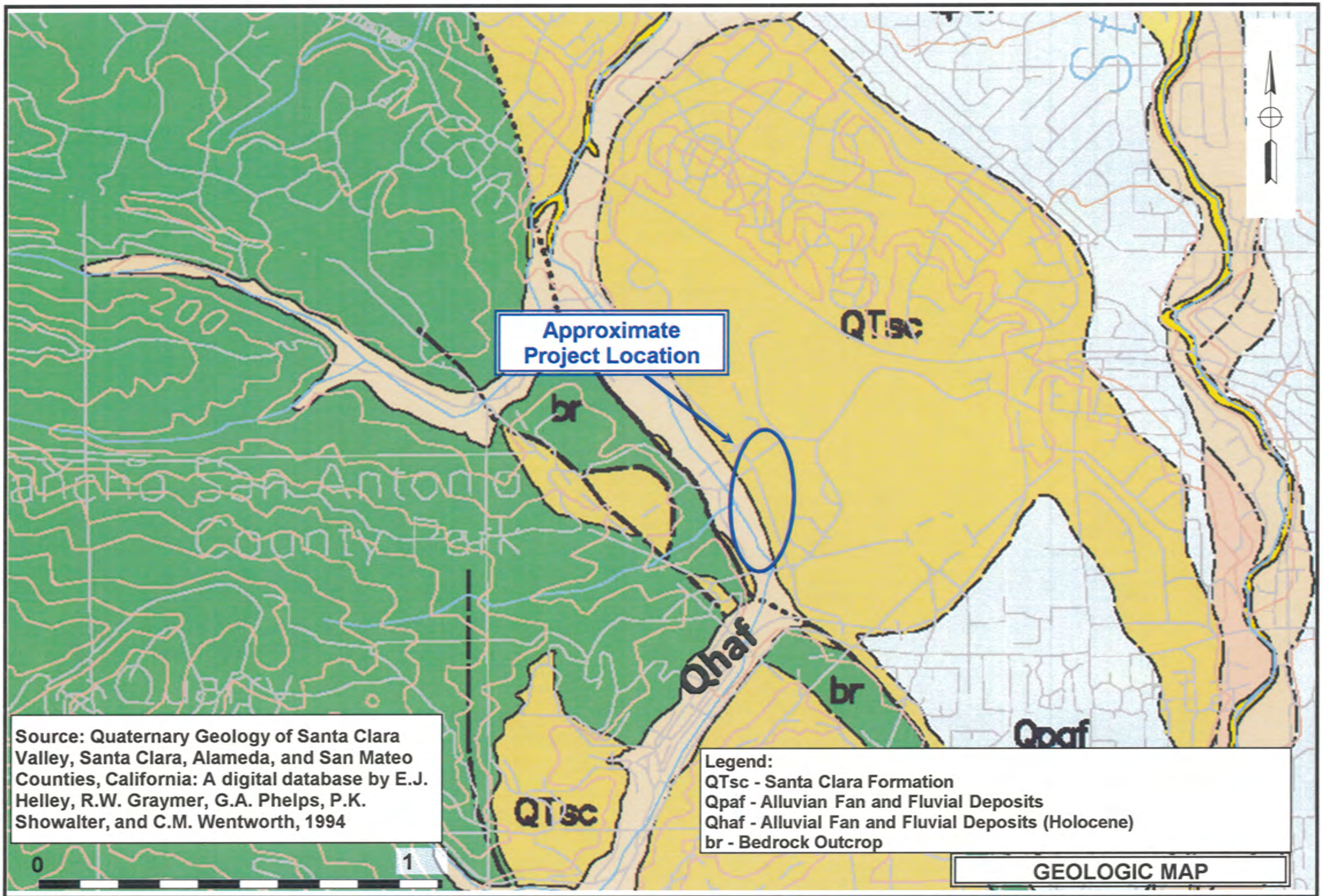
Note: All units are in feet unless otherwise specified
Reference Map was provided by Hatch Mott MacDonald

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

PERMANENTE CREEK FLOOD PROTECTION PROJECT
RANCHO SAN ANTONIO BASIN

JOB NO.:2010-108-RSA

PLATE NO: 2



Source: Quaternary Geology of Santa Clara Valley, Santa Clara, Alameda, and San Mateo Counties, California: A digital database by E.J. Helley, R.W. Graymer, G.A. Phelps, P.K. Showalter, and C.M. Wentworth, 1994

Legend:
QTsc - Santa Clara Formation
Qpaf - Alluvian Fan and Fluvial Deposits
Qhaf - Alluvial Fan and Fluvial Deposits (Holocene)
br - Bedrock Outcrop

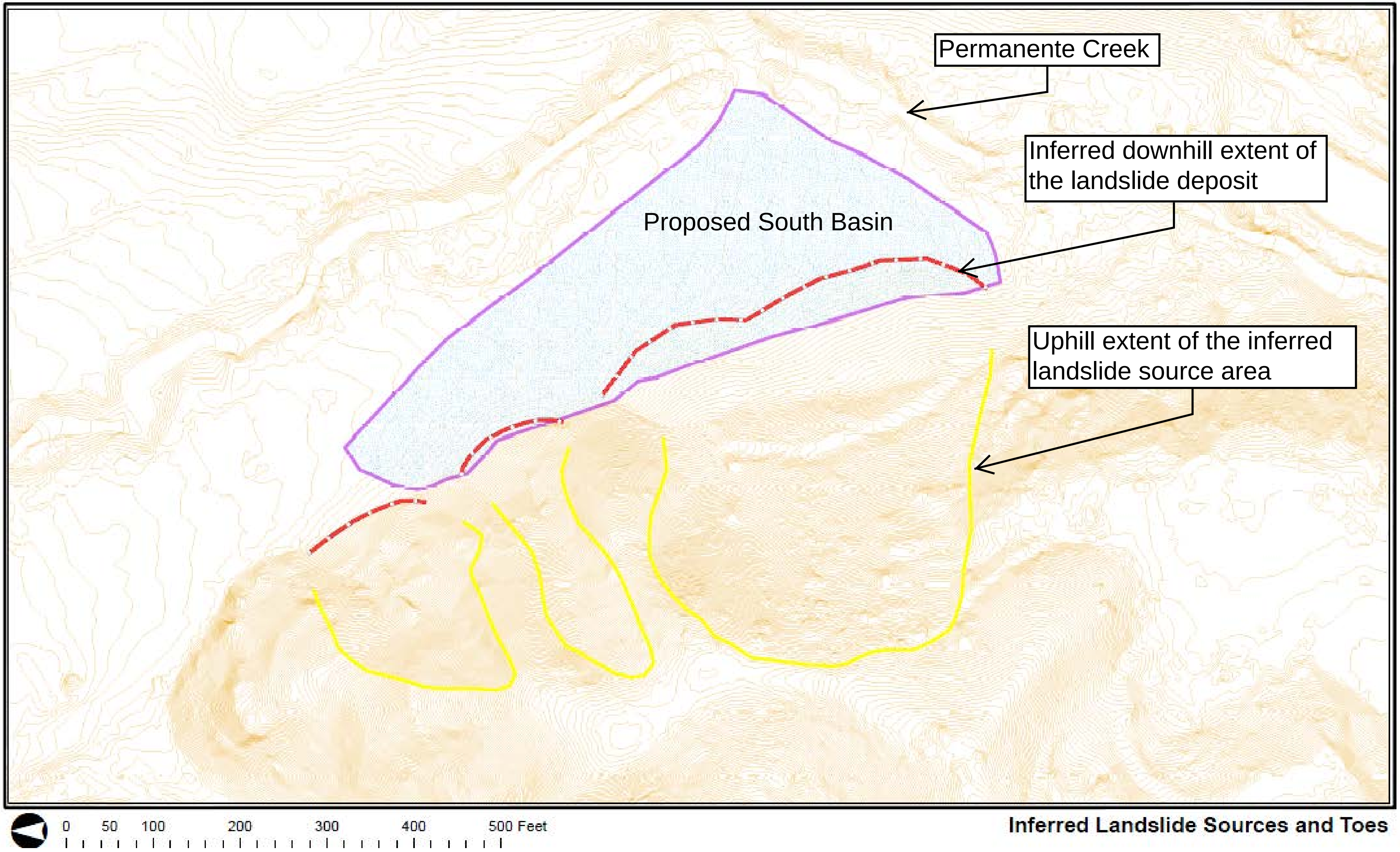
GEOLOGIC MAP

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

PERMANENTE CREEK FLOOD PROTECTION PROJECT - RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO.: 2010-108-RSA

PLATE NO.: 3


Permanente Creek
Inferred downhill extent of the landslide deposit
Proposed South Basin
Uphill extent of the inferred landslide source area
0
50
100
200
300
400
500 Feet

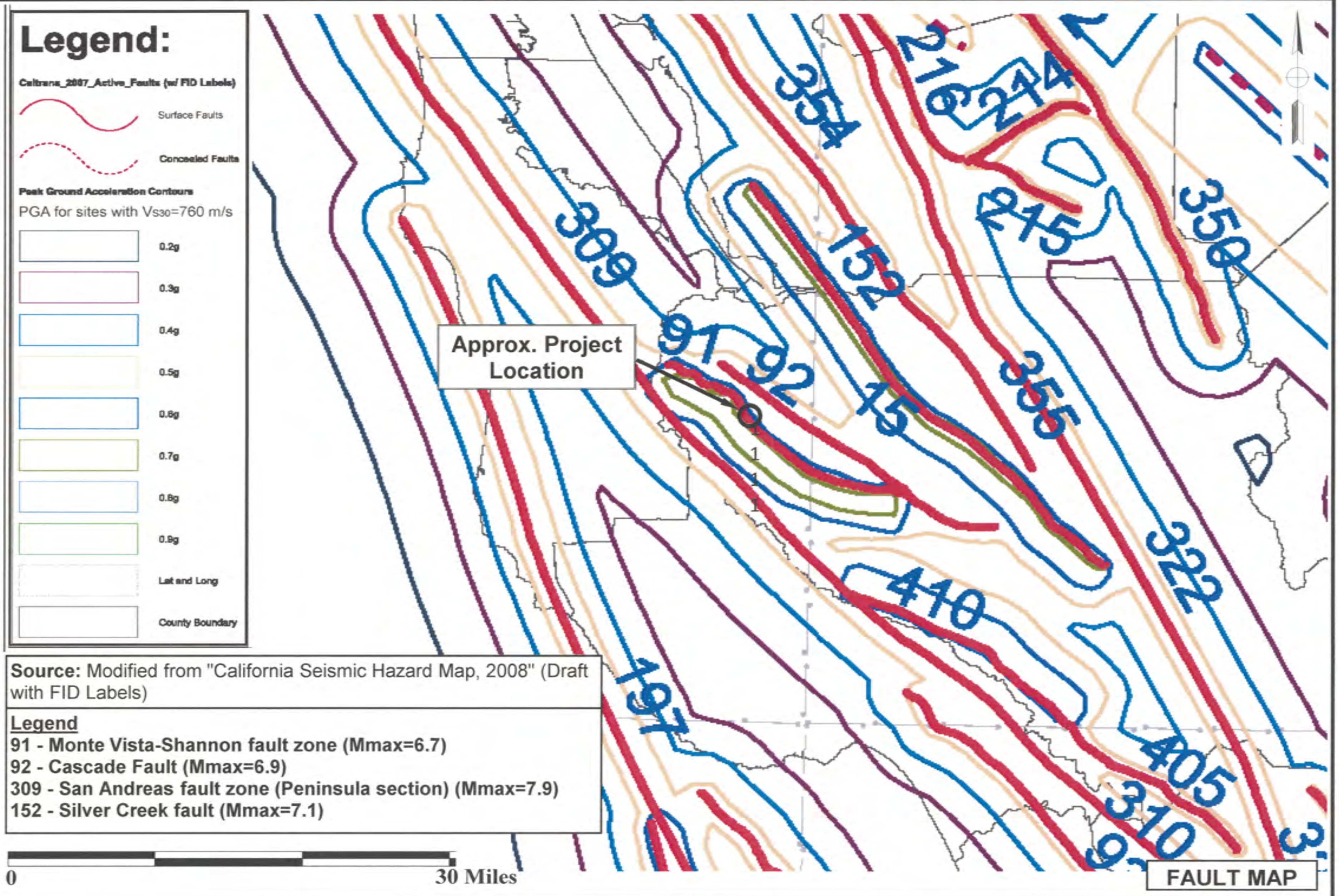
Inferred Landslide Sources and Toes

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

PERMANENTE CREEK FLOOD PROTECTION PROJECT - RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO.: 2010-108-RSA

PLATE NO.: 3A



Source: Modified from "California Seismic Hazard Map, 2008" (Draft with FID Labels)

Legend

91 - Monte Vista-Shannon fault zone (Mmax=6.7)
92 - Cascade Fault (Mmax=6.9)
309 - San Andreas fault zone (Peninsula section) (Mmax=7.9)
152 - Silver Creek fault (Mmax=7.1)

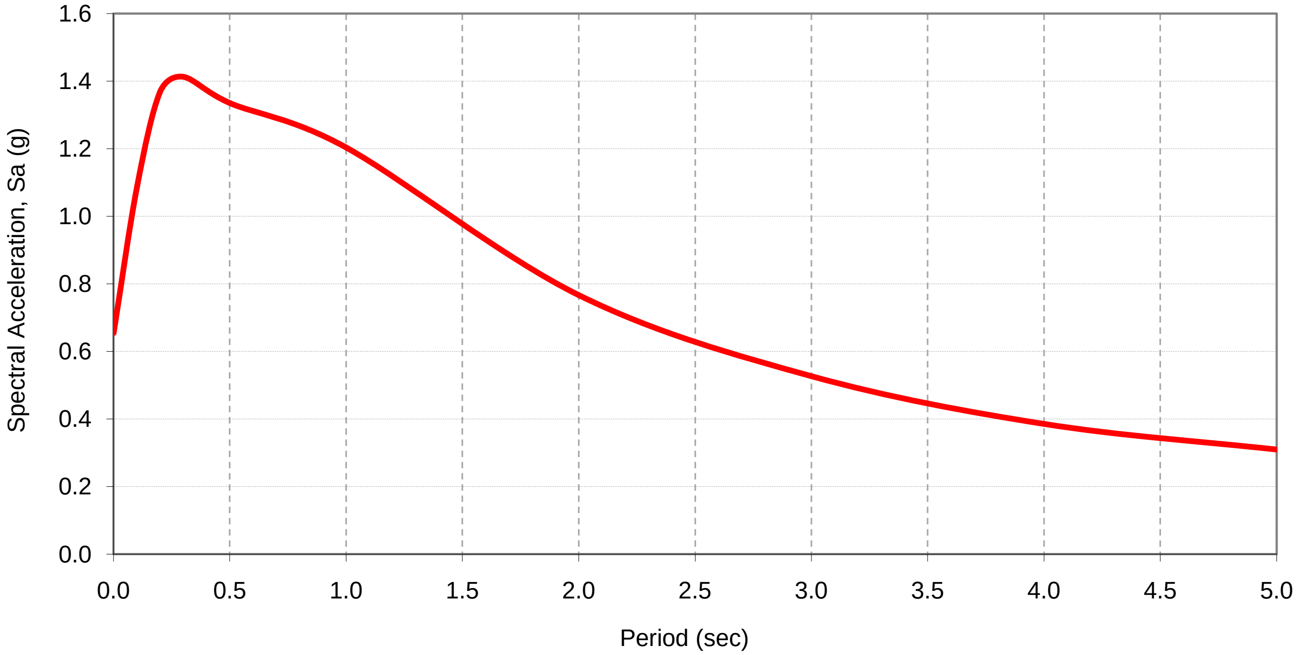
PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

PERMANENTE CREEK FLOOD PROTECTION PROJECT - RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO.: 2010-108-RSA	**PLATE NO.: 4**

RECOMMENDED ARS CURVE

Probabilistic Approach (5% Damping)



Site Information

Latitude:	37.3298
Longitude	-122.0830
V_{S30} (m/s) =	250
$Z_{1.0}$ (m) =	N/A
$Z_{2.5}$ (km) =	N/A
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	6.2

Governing Curve:

USGS Deaggregation 2008 (beta)

Recommended Response Spectrum

Period (sec)	USGS Deagg. Spectral Acceleration (g)	Adjusted for Near Fault Effect	Adjusted For Basin Effect	Final Adjusted Spectral Acceleration (g)
0.0	0.6547	1.000	1.000	0.655
0.1	1.0872	1.000	1.000	1.087
0.2	1.3678	1.000	1.000	1.368
0.3	1.4127	1.000	1.000	1.413
0.5	1.3349	1.000	1.000	1.335
1.0	1.0028	1.200	1.000	1.203
2.0	0.6385	1.200	1.000	0.766
3.0	0.4392	1.200	1.000	0.527
4.0	0.3209	1.200	1.000	0.385
5.0	0.2578	1.200	1.000	0.309

Source:

1. Caltrans ARS Online tool (V.1.0.4, http://dap3.dot.ca.gov/shake_stable/)
2. USGS Deaggregation 2008 beta (http://eqint.cr.usgs.gov/deaggint/2008/index.php)
3. Caltrans Geotechnical Services Design Manual (Version 1.0)

Note:

Refer to "Probablistic Response Spectum Spreadsheet" (attached) for development of the recommended ARS curve.

PARIKH CONSULTANTS, INC.
GEOTECHNICAL ENGINEERING
MATERIALS TESTING

PERMANENTE CREEK FLOOD PROTECTION PROJECT
RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

Project No.: 2010-108-RSA | **Plate No.: 5**

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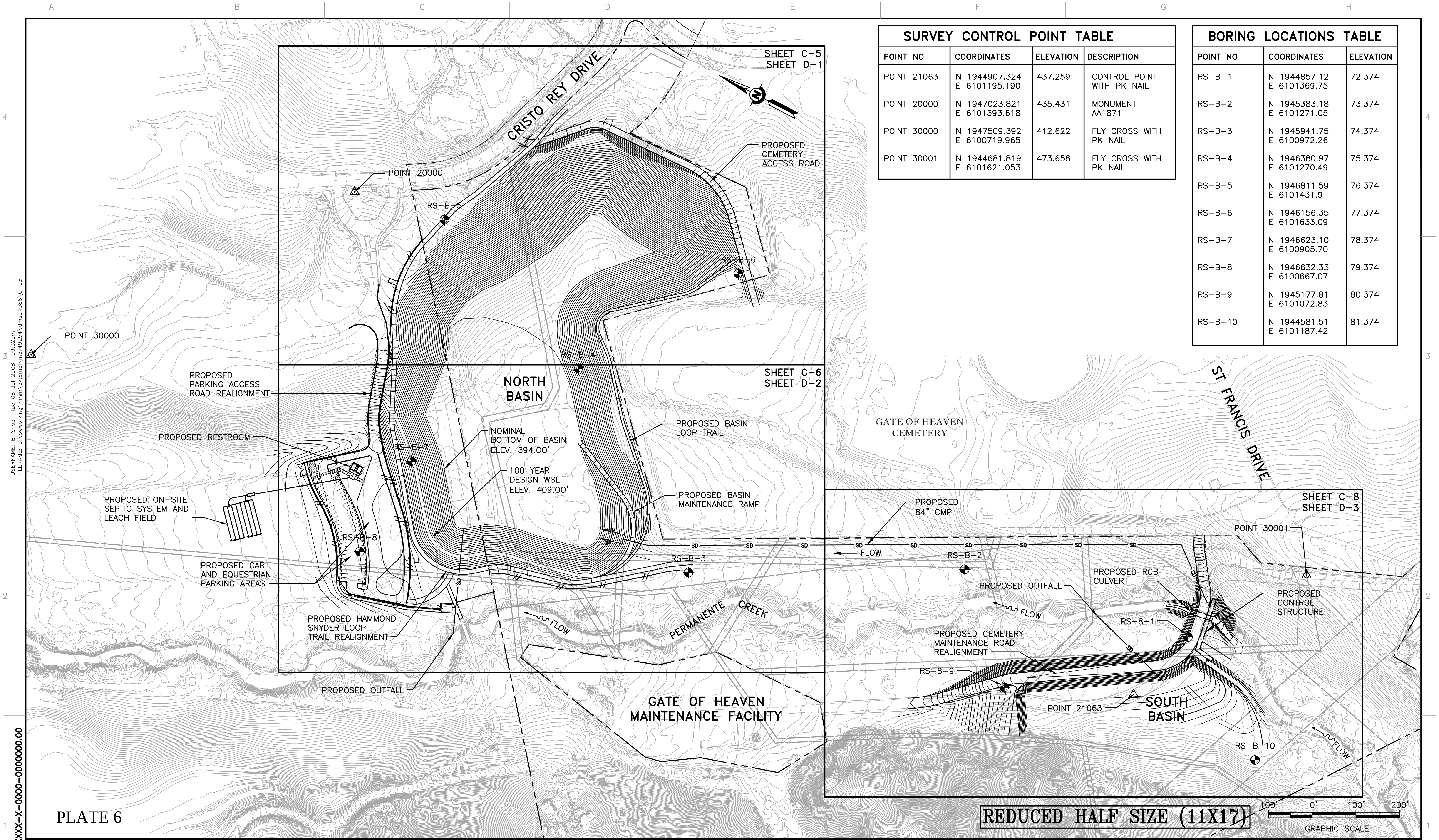

SHEET C-5
SHEET D-1
CRISTO REY DRIVE
N
PROPOSED CEMETERY ACCESS ROAD
POINT 20000
RS-B-5
RS-B-6
POINT 30000
RS-B-4
SHEET C-6
SHEET D-2
PROPOSED PARKING ACCESS ROAD REALIGNMENT
NORTH BASIN
PROPOSED RESTROOM
NOMINAL BOTTOM OF BASIN ELEV. 394.00'
PROPOSED BASIN LOOP TRAIL
GATE OF HEAVEN CEMETERY
ST FRANCIS DRIVE
RS-B-7
100 YEAR DESIGN WSL ELEV. 409.00'
PROPOSED ON-SITE SEPTIC SYSTEM AND LEACH FIELD
PROPOSED BASIN MAINTENANCE RAMP
PROPOSED 84" CMP
SHEET C-8
SHEET D-3
POINT 30001
RS-B-8
SD
FLOW
RS-B-3
RS-B-2
PROPOSED CAR AND EQUESTRIAN PARKING AREAS
PROPOSED RCB CULVERT
PROPOSED OUTFALL
PROPOSED CONTROL STRUCTURE
PERMANENTE CREEK
PROPOSED HAMMOND SNYDER LOOP TRAIL REALIGNMENT
RS-8-1
PROPOSED CEMETERY MAINTENANCE ROAD REALIGNMENT
RS-8-9
PROPOSED OUTFALL
GATE OF HEAVEN MAINTENANCE FACILITY
POINT 21063
SOUTH BASIN
RS-B-10

SURVEY CONTROL POINT TABLE

POINT NO	COORDINATES	ELEVATION	DESCRIPTION
POINT 21063	N 1944907.324 E 6101195.190	437.259	CONTROL POINT WITH PK NAIL
POINT 20000	N 1947023.821 E 6101393.618	435.431	MONUMENT AA1871
POINT 30000	N 1947509.392 E 6100719.965	412.622	FLY CROSS WITH PK NAIL
POINT 30001	N 1944681.819 E 6101621.053	473.658	FLY CROSS WITH PK NAIL

BORING LOCATIONS TABLE

POINT NO	COORDINATES	ELEVATION
RS-B-1	N 1944857.12 E 6101369.75	72.374
RS-B-2	N 1945383.18 E 6101271.05	73.374
RS-B-3	N 1945941.75 E 6100972.26	74.374
RS-B-4	N 1946380.97 E 6101270.49	75.374
RS-B-5	N 1946811.59 E 6101431.9	76.374
RS-B-6	N 1946156.35 E 6101633.09	77.374
RS-B-7	N 1946623.10 E 6100905.70	78.374
RS-B-8	N 1946632.33 E 6100667.07	79.374
RS-B-9	N 1945177.81 E 6101072.83	80.374
RS-B-10	N 1944581.51 E 6101187.42	81.374

PLATE 6

REDUCED HALF SIZE (11X17)

100' 0' 100' 200'
GRAPHIC SCALE

REV	DESCRIPTION	DATE	APPR.
A	30% REVIEW SUBMITTAL	11/11	T.S.
B	60% REVIEW SUBMITTAL	04/12	T.S.

REFERENCE INFORMATION AND NOTES

Hatch Mott MacDonald

DATE 4-16-12
DESIGN Y LIAO
DRAWN K MEYER
CHECKED G RITTER

ENGINEERING CERTIFICATION
REGISTERED PROFESSIONAL ENGINEER
TRACIE K SAKAKIHARA
C37141
CIVIL
STATE OF CALIFORNIA
PROJECT ENGINEER DATE

Santa Clara Valley Water District
ACCEPTED BY DISTRICT

PROJECT NAME AND SHEET DESCRIPTION:

PERMANENTE CREEK
FLOOD PROTECTION PROJECT

RANCHO SAN ANTONIO
SITE PLAN, SURVEY CONTROL
AND DRAWING LAYOUT INDEX

SCALE
1" = 100'

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26244001

SHEET CODE:
G-3

PAGE NUMBER:
OF

APPENDIX A

APPENDIX A

FIELD EXPLORATION

All the test borings were drilled with a truck-mounted drill rig using 8-inch diameter hollow stem auger. The soil samples were obtained from the borings during drilling at various depths by driving a 2.5 inches Inside Diameter (I. D.) Modified California Sampler or a 1.375 inches I.D. Standard Penetration Sampler (ASTM Test Method No. 1586). The sampler was driven into the subsurface soils under the impact of a 140 pounds hammer having a free fall of 30 inches. The blow counts required to drive the sampler for the last 12 inches are presented on the Logs of Test Borings, Appendix A. (When correlating standard penetration data in similar soils, the blow counts for the Modified California sampler can be taken as roughly twice that for the Standard Penetration Test sampler in similar soils.). Pocket penetration tests were also performed on clay samples to evaluate their consistency. Upon completion of drilling, the boreholes were backfilled with cement grout. Soil cuttings were placed in 55-gallon drums and were disposed off site

The borings were drilled under the technical supervision of our engineers, who classified and continuously logged the soils encountered during drilling and supervised the collection of soil samples at various depths for visual examination and laboratory testing. The soil samples were visually classified in the field according to the Unified Soil Classification System and then transported to our laboratory for further evaluation and testing.

The descriptions of the soils encountered and relevant boring information are presented on the Log of Test Borings attached in Appendix A. The laboratory test methods and results are presented in Appendix B. The logs presented in Appendix A were prepared from the field logs which were edited after visual re-examination of the soil samples in the laboratory and results of classification tests on selected soil samples as indicated on the logs.

The descriptions and related information presented on these logs of test borings depict subsurface conditions only at the locations indicated on the plan and on the particular date noted on the logs. Because of the variability from place to place within soil/rock in general, subsurface conditions at other locations may differ from conditions occurring at the locations explored. The abrupt stratum changes shown on the logs may be gradational and relatively minor changes in soil types within a stratum may not be noted on the logs due to field limitations. Also, the passage of time may result in a change in the soil conditions at these locations due to environmental changes.

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names	Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435-04)
CL	Collapse Potential (ASTM D 5333-03)
CP	Compaction Curve (CTM 216 - 06)
CR	Corrosion, Sulfates, Chlorides (CTM 643 - 99; CTM 417 - 06; CTM 422 - 06)
CU	Consolidated Undrained Triaxial (ASTM D 4767-02)
DS	Direct Shear (ASTM D 3080-04)
EI	Expansion Index (ASTM D 4829-03)
M	Moisture Content (ASTM D 2216-05)
OC	Organic Content (ASTM D 2974-07)
P	Permeability (CTM 220 - 05)
PA	Particle Size Analysis (ASTM D 422-63 [2002])
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89-02, AASHTO T 90-00)
PL	Point Load Index (ASTM D 5731-05)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301 - 00)
SE	Sand Equivalent (CTM 217 - 99)
SG	Specific Gravity (AASHTO T 100-06)
SL	Shrinkage Limit (ASTM D 427-04)
SW	Swell Potential (ASTM D 4546-03)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166-06) Unconfined Compression - Rock (ASTM D 2938-95)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850-03)
UW	Unit Weight (ASTM D 4767-04)
VS	Vane Shear (AASHTO T 223-96 [2004])

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler
- Modified California Sampler
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

▽ First Water Level Reading (during drilling)
▼ Static Water Level Reading (short-term)
▼ Static Water Level Reading (long-term)

BORING RECORD LEGEND

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASIN

CUPERTINO, CALIFORNIA

Date: 11/8/2011

Job No.: 2010-108-RSA

This log is part of the report prepared by Parikh Consultants, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

Plate: A-1A

CONSISTENCY OF COHESIVE SOILS

Descriptor	Unconfined Compressive Strength (tsf)	Pocket Penetrometer (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS

Descriptor	SPT N_{60} - Value (blows / foot)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Descriptor	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE

Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS

Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION

Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptors and associated criteria for required soil description components only.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

BORING RECORD LEGEND

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

Date: 11/8/2011

Job No.: 2010-108-RSA

This log is part of the report prepared by Parikh Consultants, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

Plate:
A-1B

LOGGED BY El Bhangoo	BEGIN DATE 8-5-10	COMPLETION DATE 8-5-10	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 122° 4' 59.16" / 37° 19' 31.55"
DRILLING CONTRACTOR EGS			BOREHOLE LOCATION (Offset, Station, Line) SEE SITE PLAN
DRILLING METHOD Hollow-Stem Auger			DRILL RIG CME 75
SAMPLER TYPE(S) AND SIZE(S) (ID) MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)			SPT HAMMER TYPE 140 lbs
BOREHOLE BACKFILL AND COMPLETION Cement grout			GROUNDWATER READINGS — DURING DRILLING: 13.0 ft — AFTER DRILLING (DATE): Not monitored

HOLE ID	**RS-B-1**
SURFACE ELEVATION	436.8 ft NAVD88
BOREHOLE DIAMETER	8 in
HAMMER EFFICIENCY, ERi	60%
TOTAL DEPTH OF BORING	44.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	0	SANDY SILT with GRAVEL (ML); medium stiff; brown; moist; some fine GRAVEL.									
	1		1	10 7 5	12	10	111	PP = >4	100		
434.8	2										
	3	SANDY lean CLAY (CL); soft; dark brown; moist.									
432.8	4		2	3 3 3	6	18	93	PP = 2.3	100		
	5										PI
430.8	6										
	7										
428.8	8										
	9	Medium stiff.	3	5 6 7	13	14	115		100		
426.8	10										
	11										
424.8	12	SANDY lean CLAY with GRAVEL (CL); hard; brown; moist; some coarse to fine GRAVEL.									
	▽ 13										
422.8	14		4	22 50/1.5"	50/2	16			28		
	15										
420.8	16										
	17										
418.8	18										
	19		5	7 4 50/5"	54/11	18			61		
	20										

(continued)

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

Date: 6/28/2011 Job No.: 2010-108-RSA

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Plate:
A-2A

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	20		SANDY lean CLAY with GRAVEL (CL); hard; brown; moist; some coarse to fine GRAVEL.												
	21														
414.8	22														
	23														
412.8	24		Reddish brown; wet; coarse to medium SAND.		6	16 26 30	56	19			83				
	25		SANDY lean CLAY with GRAVEL (CL); hard; brown; moist; some coarse to fine GRAVEL.												
410.8	26														
	27		Lean CLAY with SAND (CL); hard; brown; wet; some fine GRAVEL; black mottling.												
408.8	28														
	29				7	16 29 26	55	25	102	UC = 1.3	89				
406.8	30														
	31														
404.8	32														
	33														
402.8	34				8	10 22 50/5"	72/11	19			67				
	35														
400.8	36														
	37		CLAYEY SAND with GRAVEL (SC); very dense; brown; wet.												
398.8	38														
	39				9	15 50/5"	50/5	18	116		56				
396.8	40														
	41														
394.8	42														
	43				10	22 50/6"	50/6				50				
	44														

(continued)

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

Date: 6/28/2011

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Plate:
A-2B

PCI-CT 5 BR 2010-108-RSA.GPJ TEMPLATE 7-22-11.GDT 11/8/11

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
		▨	CLAYEY SAND with GRAVEL (SC). *layer description continued from previous page*		10		50/6	18			50				
	45		Groundwater was encountered @ 13.0 feet during drilling. Borehole was grouted upon completion. Bottom of borehole at 44.5 ft bgs/Elev. 392.3 ft.												
390.8	46														
	47														
388.8	48														
	49														
386.8	50														
	51														
384.8	52														
	53														
382.8	54														
	55														
380.8	56														
	57														
378.8	58														
	59														
376.8	60														
	61														
374.8	62														
	63														
372.8	64														
	65														
370.8	66														
	67														
368.8	68														

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASIN

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate: A-2C

LOGGED BY **El Bhangoo**	BEGIN DATE **8-5-10**	COMPLETION DATE **8-5-10**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **122° 5' 0.85" / 37° 19' 36.73"**	HOLE ID **RS-B-2**
DRILLING CONTRACTOR **EGS**			BOREHOLE LOCATION (Offset, Station, Line) **SEE SITE PLAN**	SURFACE ELEVATION **431.2 ft NAVD88**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)**			SPT HAMMER TYPE **140 lbs**	HAMMER EFFICIENCY, ERi **60%**
BOREHOLE BACKFILL AND COMPLETION **Cement grout**			GROUNDWATER READINGS — DURING DRILLING **Not measured** — AFTER DRILLING (DATE) **Not monitored**	TOTAL DEPTH OF BORING **30.5 ft**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	0	SILT with GRAVEL (ML); very stiff; brown; dry; coarse to fine GRAVEL; few coarse to fine SAND.									
	1		1	10 14 19	33	5			61		
429.2	2										
	3										
427.2	4	Poorly graded GRAVEL with CLAY and SAND (GP-GC); medium dense; reddish brown; moist; coarse to fine SAND; weathered rock fragments.	2	11 15 19	34	9			56		
	5										
425.2	6										
	7										
423.2	8	CLAYEY SAND with GRAVEL (SC); medium dense; reddish brown; moist; fine GRAVEL; coarse to fine SAND.									
	9		3	8 15 18	33	16			61		
421.2	10	Fine SAND; little caliche.									
	11										
419.2	12										
	13	Lean CLAY with SAND (CL); very stiff; brown; moist; coarse to fine GRAVEL; coarse to fine SAND.									
417.2	14		4	7 14 20	34	24	103		67		TX-CU PI
	15										
415.2	16										
	17										
413.2	18	CLAYEY SAND with GRAVEL (SC); dense; reddish brown; moist.									
	19		5		55				61		
	20										

(continued)

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

Date: 6/28/2011 Job No.: 2010-108-RSA

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Plate: A-3A

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	20		CLAYEY SAND with GRAVEL (SC); dense; reddish brown; moist.		5	16 25 30	55	14			61				
	21														
409.2	22														
	23														
407.2	24				6	21 45 50/5.5"	95/12	15			67				
	25		CLAYEY SAND with GRAVEL (SC); dense; reddish brown; moist.												
405.2	26														
	27		CLAYEY GRAVEL (GC); dense; reddish brown; moist; trace coarse to fine SAND.												
403.2	28														
	29				7	26 39 50/5.5"	89/12	15			61				
401.2	30														
	31		Groundwater depth could not be measured because large amount of water was used due to hard drilling conditions.												
399.2	32		Borehole was grouted upon completion. Bottom of borehole at 30.5 ft bgs/Elev. 400.7 ft.												
	33														
397.2	34														
	35														
395.2	36														
	37														
393.2	38														
	39														
391.2	40														
	41														
389.2	42														
	43														
	44														

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASIN

CUPERTINO, CALIFORNIA

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate:
A-3B

LOGGED BY **El Bhangoo**	BEGIN DATE **8-5-10**	COMPLETION DATE **8-5-10**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **122° 5' 4.31" / 37° 19' 42.2"**		HOLE ID **RS-B-3**
DRILLING CONTRACTOR **EGS**			BOREHOLE LOCATION (Offset, Station, Line) **SEE SITE PLAN**		SURFACE ELEVATION **414.5 ft NAVD88**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**		BOREHOLE DIAMETER **8 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)**			SPT HAMMER TYPE **140 lbs**		HAMMER EFFICIENCY, ERi **60%**
BOREHOLE BACKFILL AND COMPLETION **Cement grout**			GROUNDWATER READINGS	DURING DRILLING **Not measured** AFTER DRILLING (DATE) **Not monitored**	TOTAL DEPTH OF BORING **30.5 ft**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	0	SANDY SILT (ML); stiff; dark brown; dry; coarse to fine SAND.									
	1		1	6 8 9	17	12	92	PP = >4	61		
412.5	2										
	3										
410.5	4	CLAYEY SAND with GRAVEL (SC); medium dense; dark brown; dry to moist; coarse to fine GRAVEL.	2	8 10 16	26	7			56		
	5										PA
408.5	6										
	7										
406.5	8	Lean CLAY (CL); medium stiff; dark brown; moist; low to medium plasticity fines.									
	9		3	4 5 5	10	13	113		56		
404.5	10										CR
	11										
402.5	12										
	13	SILTY SAND with GRAVEL (SM); medium dense; dark brown; moist; coarse to fine GRAVEL; coarse to fine SAND.									
400.5	14		4	10 22 33	55	7			61		
	15										
398.5	16										
	17										
396.5	18										
	19	Dense.	5		83/12				67		
	20										

(continued)

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate:
A-4A

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	20		SILTY SAND with GRAVEL (SM); medium dense; dark brown; moist; coarse to fine GRAVEL; coarse to fine SAND.		5	17 33 50/6"	83/12	7			67				
	21														
392.5	22														
	23														
390.5	24				6	36 42 50/5"	92/11	13			56				
	25		SILTY SAND with GRAVEL (SM); very dense; dark brown; moist; coarse to fine GRAVEL; coarse to fine SAND.												
388.5	26														
	27														
386.5	28		Hard to drill, water was added.												Hard to drill, water was added.
	29				7	26 50/6"	50/6	13			67				
384.5	30														
	31		Groundwater depth could not be measured because large amount of water was used due to hard drilling conditions.												
382.5	32		Borehole was grouted upon completion. Bottom of borehole at 30.5 ft bgs/Elev. 384 ft.												
	33														
380.5	34														
	35														
378.5	36														
	37														
376.5	38														
	39														
374.5	40														
	41														
372.5	42														
	43														
	44														

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate:
A-4B

LOGGED BY **El Bhangoo**	BEGIN DATE **6-28-11**	COMPLETION DATE **6-28-11**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **122° 5' 3.98" / 37° 19' 42.38"**
DRILLING CONTRACTOR **EGS**			BOREHOLE LOCATION (Offset, Station, Line) **SEE SITE PLAN**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**
SAMPLER TYPE(S) AND SIZE(S) (ID) **MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)**			SPT HAMMER TYPE **140 lbs**
BOREHOLE BACKFILL AND COMPLETION **Cement grout**			GROUNDWATER READINGS: DURING DRILLING **18.0 ft**; AFTER DRILLING (DATE) **Not monitored**

HOLE ID	**RS-B-3 (w)**
SURFACE ELEVATION	**414.9 ft NAVD88**
BOREHOLE DIAMETER	**8 in**
HAMMER EFFICIENCY, ERi	**60%**
TOTAL DEPTH OF BORING	**40.0 ft**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	0	SANDY lean CLAY (CL); stiff; brown; moist; low plasticity fines.									
	1		1	5 6 8	14	9		PP = >4	72		
412.9	2										
	3	SILTY SAND (SM); medium dense; brown; moist; mostly medium to fine SAND; little fines.									
410.9	4	CLAYEY GRAVEL with SAND (GC); medium dense; brown; moist; about 44% GRAVEL; about 40% medium to fine SAND; about 16% fines.	2	8 11 14	25	6			72		PA
	5										
408.9	6										
	7										
406.9	8										
	9	Dense.	3	21 36 28	64	4			67		
404.9	10										
	11										
402.9	12	SILTY GRAVEL with SAND (GM); dense; brown; moist; little coarse to medium SAND; trace fines.									
	13										
400.9	14		4	16 28 50	78	8			61		
	15										
398.9	16										
	17										
396.9 ▽	18										
	19		5	15 23 50/5"	73/11	10			61		
	20										

(continued)

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

Date: 6/28/2011

Job No.: 2010-108-RSA

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ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	20	SILTY GRAVEL with SAND (GM); dense; brown; moist; little coarse to medium SAND; trace fines.									
	21										
392.9	22	SILTY SAND with GRAVEL (SM); very dense; brown; wet; little fine GRAVEL; coarse to medium SAND; trace fines.									
	23										
390.9	24		6	18 25 50/3"	75/9	10			56		
	25										
388.9	26	CLAYEY SAND with GRAVEL (SC); dense; brown; wet; mostly coarse to medium SAND; little fines.									
	27										
386.9	28										
	29		7	21 30 41	71	12			67		
384.9	30										
	31										
382.9	32	Lean CLAY (CL); very stiff; brown; wet; low to medium plasticity fines.									
	33										
380.9	34		8	12 20 21	41	22		PP = >4	78		
	35										
378.9	36										
	37										
376.9	38										
	39	Hard.	9	14 23 30	53	17		PP = >4	56		
374.9	40										
	41										
372.9	42										
	43										
	44										

Groundwater encountered at 18 feet during drilling.

Borehole was grouted upon completion.

Well with screening between 15' to 40'. 28' #3 Sand; 3' bentonite and 9' of cement grout to the top.
Bottom of borehole at 40.0 ft bgs/Elev. 374.9 ft.

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
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CUPERTINO, CALIFORNIA

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Plate:
A-5B

LOGGED BY **El Bhangoo** BEGIN DATE **8-5-10** COMPLETION DATE **8-5-10**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **122° 5' 0.71" / 37° 19' 46.6"**	HOLE ID **RS-B-4 (w)**
DRILLING CONTRACTOR **EGS**	BOREHOLE LOCATION (Offset, Station, Line) **SEE SITE PLAN**	SURFACE ELEVATION **410.4 ft NAVD88**
DRILLING METHOD **Hollow-Stem Auger**	DRILL RIG **CME 75**	BOREHOLE DIAMETER **8 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)**	SPT HAMMER TYPE **140 lbs**	HAMMER EFFICIENCY, ERi **60%**
BOREHOLE BACKFILL AND COMPLETION **Cement grout**	GROUNDWATER READINGS DURING DRILLING **21.0 ft** AFTER DRILLING (DATE) **Not monitored**	TOTAL DEPTH OF BORING **40.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	0		SANDY lean CLAY with GRAVEL (CL); very stiff; brown; moist; coarse to fine GRAVEL.												
	1				1	9 14 20	34	15			89				
408.4	2														
	3														
406.4	4				2	14 31 40	71	10			67				
			CLAYEY SAND (SC); dense; yellowish brown; moist; some SILT, with weathered SILTSTONE..												
	5														
404.4	6														
	7														
402.4	8														
	9				3	25 57 50/5"	107/11	22	102	PP = >4	61				
400.4	10		Very dense.												
	11														
398.4	12		Lean CLAY with SAND (CL); very stiff to hard; reddish brown; moist; coarse to fine GRAVEL.												
	13														
396.4	14				4	14 18 31	49	23	105		100				TX-CU PI
	15														
394.4	16														
	17														
392.4	18														
	19				5	11 16 30	46	18			72				
	20														

(continued)

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

Date: 6/28/2011

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Plate:
A-6A

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	20		CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist; medium SAND.												
▽	21														
388.4	22														
	23														
386.4	24				6	6 10 20	30	17			78				PA
	25		CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist; medium SAND.												
384.4	26														
	27														
382.4	28														
	29				7	16 50/5"	50/5				50				
380.4	30		Very dense; some fine GRAVEL; medium SAND.					16							
	31														
378.4	32														
	33														
376.4	34		Very dense.		8	50/5"	REF	15			28				
	35														
374.4	36														
	37														
372.4	38														
	39		Dense.		9	17 30 50/5"	80/11	16			56				
370.4	40														
	41														
368.4	42														
	43														
	44														

Groundwater was encountered @ 21.0 feet during drilling.

Borehole was grouted upon completion.

Well with screening between 20' to 40'. 22' #3 Sand; 2' bentonite and 16' of cement grout to the top.
Bottom of borehole at 40.0 ft bgs/Elev. 370.4 ft.

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

Date: 6/28/2011

Job No.: 2010-108-RSA

This log is part of the report prepared by Parikh Consultants, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

Plate: A-6B

LOGGED BY **El Bhangoo**	BEGIN DATE **8-5-10**	COMPLETION DATE **8-5-10**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **122° 4' 58.8" / 37° 19' 50.88"**
DRILLING CONTRACTOR **EGS**			BOREHOLE LOCATION (Offset, Station, Line) **SEE SITE PLAN**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**
SAMPLER TYPE(S) AND SIZE(S) (ID) **MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)**			SPT HAMMER TYPE **140 lbs**
BOREHOLE BACKFILL AND COMPLETION **Cement grout**			GROUNDWATER READINGS — DURING DRILLING **Not measured** — AFTER DRILLING (DATE) **Not monitored**

HOLE ID	**RS-B-5**
SURFACE ELEVATION	**435.5 ft NAVD88**
BOREHOLE DIAMETER	**8 in**
HAMMER EFFICIENCY, ERi	**60%**
TOTAL DEPTH OF BORING	**30.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	0		SILTY SAND with GRAVEL (SM); medium dense; brown; dry; fine GRAVEL; coarse to fine SAND.												
	1				1	22 22 16	38	10			44				
433.5	2														
	3														
431.5	4		Dense; reddish brown.		2	32 37 41	78	11			56				
	5														
429.5	6														
	7														
427.5	8		SANDY lean CLAY (CL); very stiff; reddish brown; moist; coarse to fine SAND.												
	9				3	13 16 21	37	20	109	PP = >4.0	67				
425.5	10														
	11														
423.5	12														
	13		Lean CLAY with SAND (CL); hard; reddish brown; moist.												Hard to drill, water was added.
421.5	14				4	22 31 36	67	21	107	PP = >4.0	78				
	15														
419.5	16														
	17														
417.5	18		CLAYEY GRAVEL with SAND (GC); dense; reddish brown; moist.												
	19				5		51				100				
	20														

(continued)

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate: A-7A

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	20	CLAYEY GRAVEL with SAND (GC); dense; reddish brown; moist.	5	12 20 31	51	18			100		
	21										
413.5	22										
	23	SANDY lean CLAY (CL); very stiff; reddish brown; moist.									
411.5	24		6	13 17 27	44	28	99	PP = >4.0	56		
	25										
409.5	26										
	27	CLAYEY GRAVEL with SAND (GC); very dense; reddish brown; moist; coarse to fine GRAVEL.									
407.5	28										
	29		7	28 50/6"	50/6	12			61		
405.5	30										
	31	Groundwater depth could not be measured because large amount of water was used due to hard drilling conditions. Borehole was grouted upon completion. Bottom of borehole at 30.5 ft bgs/Elev. 405 ft.									
403.5	32										
	33										
401.5	34										
	35										
399.5	36										
	37										
397.5	38										
	39										
395.5	40										
	41										
393.5	42										
	43										
	44										

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI
CUPERTINO, CALIFORNIA

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate:
A-7B

LOGGED BY El Bhangoo	BEGIN DATE 8-5-10	COMPLETION DATE 8-5-10	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 122° 4' 56.17" / 37° 19' 44.44"	HOLE ID **RS-B-6**
DRILLING CONTRACTOR EGS			BOREHOLE LOCATION (Offset, Station, Line) SEE SITE PLAN	SURFACE ELEVATION 425.8 ft NAVD88
DRILLING METHOD Hollow-Stem Auger			DRILL RIG CME 75	BOREHOLE DIAMETER 8 in
SAMPLER TYPE(S) AND SIZE(S) (ID) MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)			SPT HAMMER TYPE 140 lbs	HAMMER EFFICIENCY, ERi 60%
BOREHOLE BACKFILL AND COMPLETION Cement grout			GROUNDWATER READINGS — DURING DRILLING 27.0 ft — AFTER DRILLING (DATE) Not monitored	TOTAL DEPTH OF BORING 30.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY SAND with GRAVEL (SC); dense; brown; moist; coarse to fine GRAVEL.												
	1														
423.8	2				1	21 26 30	56	12			67				
	3		SANDY lean CLAY (CL); stiff; brown; moist; coarse to fine GRAVEL.												
421.8	4				2	9 8 15	23	24	99	PP = 2	72				
	5														
419.8	6														
	7														
417.8	8		CLAYEY SAND with GRAVEL (SC); loose; brown; moist; with some SANDSTONE fragments.												
	9				3	7 7 9	16	21	106	PP = 1.3	72				
415.8	10														
	11														
413.8	12		Lean CLAY with SAND (CL); very stiff; dark brown; moist to wet.												
	13														
411.8	14				4	11 17 26	43	20	107	PP = 1.8 UC = 2.3	89				
	15														
409.8	16														
	17														
407.8	18														
	19		Hard; coarse to fine GRAVEL.		5	21 28 42	70	19	110	PP = >4	78				
	20														

(continued)

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate:
A-8A

PCI-CT 5 BR 2010-108-RSA.GPJ TEMPLATE 7-22-11.GDT 11/8/11

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	20		Lean CLAY with SAND (CL); very stiff; dark brown; moist to wet.												
	21														
403.8	22		SANDY lean CLAY (CL); hard; brown; moist.												
	23														
401.8	24				6	30 50/6"	50/6	15			56				
	25		SANDY lean CLAY (CL); hard; brown; moist.												
399.8	26														
	▽ 27		SILTY SAND with GRAVEL (SM); very dense; brown; wet.												
397.8	28														
	29				7	20 48 50/4"	98/10	12			0				
395.8	30														
	31														
393.8	32														
	33														
391.8	34														
	35														
389.8	36														
	37														
387.8	38														
	39														
385.8	40														
	41														
383.8	42														
	43														
	44														

Groundwater was encountered @ 27.0 feet during drilling.

Borehole was grouted upon completion.
Bottom of borehole at 30.0 ft bgs/Elev. 395.8 ft.

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASIN

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate:
A-8B

LOGGED BY **El Bhangoo** · BEGIN DATE **6-20-11** · COMPLETION DATE **6-20-11**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **122° 5' 5.57" / 37° 19' 48.76"**	HOLE ID **RS-B-7**
DRILLING CONTRACTOR **EGS**	BOREHOLE LOCATION (Offset, Station, Line) **SEE SITE PLAN**	SURFACE ELEVATION **402.6 ft NAVD88**
DRILLING METHOD **Hollow-Stem Auger**	DRILL RIG **CME 75**	BOREHOLE DIAMETER **8 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)**	SPT HAMMER TYPE **140 lbs**	HAMMER EFFICIENCY, ERi **60%**
BOREHOLE BACKFILL AND COMPLETION **Cement grout**	GROUNDWATER READINGS · DURING DRILLING **22.0 ft** · AFTER DRILLING (DATE) **Not monitored**	TOTAL DEPTH OF BORING **25.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	0		GRAVELLY lean CLAY with SAND (CL); very stiff; brown; moist; little fine GRAVEL; few fine SAND; low plasticity fines.												
	1				1	7 16 17	33	12		PP = >4	83				
400.6	2														
	3		SILTY SAND with GRAVEL (SM); loose; brown; moist; about 22% little fine GRAVEL; about 67% medium to fine SAND; about 11% few fines.												
398.6	4				2	6 5 5	10	6			89				
	5		Poorly graded SAND with SILT and GRAVEL (SP-SM); loose; brown; moist; medium to fine SAND.												PA
396.6	6														
	7		Lean CLAY with SAND (CL); medium stiff; brown; moist; coarse to medium SAND; low to medium plasticity fines.												
394.6	8														
	9				3	4 5 7	12	9			100				
392.6	10														
	11														
390.6	12		CLAYEY SAND (SC); medium dense; brown; wet; coarse SAND; little fines.												
	13														
388.6	14				4	12 20 27	47	14			72				
	15														
386.6	16														
	17														
384.6	18														
	19				5	10 19 20	39	18	116	PP = >4	78				
	20														

(continued)

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASIN

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate:

A-9A

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	20	CLAYEY SAND (SC); medium dense; brown; wet; coarse SAND; little fines.									
	21										
380.6 ▽	22	SILTY CLAY with SAND (CL-ML); very stiff; brown; wet; little coarse to medium SAND; low plasticity fines.									
	23		6	10	23				61		
378.6	24	CLAYEY SAND with GRAVEL (SC); medium dense; brown; wet; about 15% GRAVEL; about 62% coarse to medium SAND; about 23% fines.		11 12		21					PA
	25										
376.6	26										
	27										
374.6	28										
	29										
372.6	30										
	31										
370.6	32										
	33										
368.6	34										
	35										
366.6	36										
	37										
364.6	38										
	39										
362.6	40										
	41										
360.6	42										
	43										
	44										

Column headings also printed: Material Graphics; Sample Depth; Drilling Method; Casing Depth

Groundwater encountered at 22 feet during drilling.

Borehole was grouted upon completion.
Bottom of borehole at 25.0 ft bgs/Elev. 377.6 ft.

LOG OF TEST BORING

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate: A-9B

LOGGED BY **El Bhangoo**	BEGIN DATE **6-20-11**	COMPLETION DATE **6-20-11**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **122° 5' 8.3" / 37° 19' 49.3"**	HOLE ID **RS-B-8**
DRILLING CONTRACTOR **EGS**			BOREHOLE LOCATION (Offset, Station, Line) **SEE SITE PLAN**	SURFACE ELEVATION **398.5 ft NAVD88**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)**			SPT HAMMER TYPE **140 lbs**	HAMMER EFFICIENCY, ERi **60%**
BOREHOLE BACKFILL AND COMPLETION **Cement grout**			GROUNDWATER READINGS — DURING DRILLING **13.5 ft** — AFTER DRILLING (DATE) **Not monitored**	TOTAL DEPTH OF BORING **25.0 ft**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	0	CLAYEY SAND (SC); medium dense; brown; moist; fine SAND; little fines; some gravels up to 1/4 inch in diameter.									
	1		1	6 12 24	36	10	119	PP = >4	89		
396.5	2										
	3	SILTY SAND with GRAVEL (SM); medium dense; brown; moist; about 32% GRAVEL; about 55% medium to fine SAND; about 13% fines.	2	12 11 9	20	6	101		67		
394.5	4										
	5										PA
392.5	6										
	7	Lean CLAY (CL); medium stiff; brown; moist; low to medium plasticity fines.									
390.5	8		3	4 6 7	13	27	89	PP = 1.5	89		
	9										
388.5	10										CR
	11										
386.5	12										
	13	▽									
384.5	14	Lean CLAY with GRAVEL (CL); medium stiff; brown; wet; little fine GRAVEL; few SAND; low to medium plasticity fines.	4	6 8 11	19	18	112	UC = 0.25	83		
	15										
382.5	16										
	17	GRAVELLY lean CLAY with SAND (CL); hard; brown; wet; little fine GRAVEL; little SAND; low plasticity fines.									
380.5	18										
	19		5	27 28 45	73	15	120	PP = 1	72		
	20										

(continued)

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASIN

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

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Plate:

A-10A

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	20		GRAVELLY lean CLAY with SAND (CL); hard; brown; wet; little fine GRAVEL; little SAND; low plasticity fines.												
	21														
376.5	22														
	23														
374.5	24				6	50/1"	REF	15			6				
	25														
372.5	26														
	27														
370.5	28														
	29														
368.5	30														
	31														
366.5	32														
	33														
364.5	34														
	35														
362.5	36														
	37														
360.5	38														
	39														
358.5	40														
	41														
356.5	42														
	43														
	44														

Groundwater encountered at 13.5 feet during drilling.

Borehole was grouted upon completion.
Bottom of borehole at 25.0 ft bgs/Elev. 373.5 ft.

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

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Plate:
A-10B

LOGGED BY **El Bhangoo**	BEGIN DATE **6-20-11**	COMPLETION DATE **6-20-11**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **122° 5' 3.48" / 37° 19' 35.11"**	HOLE ID **RS-B-9**
DRILLING CONTRACTOR **EGS**			BOREHOLE LOCATION (Offset, Station, Line) **SEE SITE PLAN**	SURFACE ELEVATION **429.1 ft NAVD88**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8 in**
SAMPLER TYPE(S) AND SIZE(S) (ID) **MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)**			SPT HAMMER TYPE **140 lbs**	HAMMER EFFICIENCY, ERi **60%**
BOREHOLE BACKFILL AND COMPLETION **Cement grout**			GROUNDWATER READINGS — DURING DRILLING **Not encountered** — AFTER DRILLING (DATE) **Not monitored**	TOTAL DEPTH OF BORING **25.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	0		Lean CLAY (CL); medium stiff; brown; moist; low to medium plasticity fines.												
	1				1	3 5 9	14	15	108	PP = 3.25	100				
427.1	2														
	3														
425.1	4		Stiff.		2	8 10 15	25				89				
	5														TX-CU
423.1	6														
	7														
421.1	8														
	9		Stiff.		3	4 9 15	24	10	118	PP = >4	61				
419.1	10		CLAYEY GRAVEL (GC); very dense; brown; moist; little fines.												
	11														
417.1	12														
	13														
415.1	14		SILTY SAND (SM); dense; brown; moist; medium to fine SAND; little fines.		4	18 23 19	42	14			72				
	15														
413.1	16														
	17														
411.1	18		Lean CLAY (CL); very stiff; brown; moist; low to medium plasticity fines.												
	19				5	9 12 16	28	9			83				
	20														

(continued)

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ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	20		Lean CLAY (CL); very stiff; brown; moist; low to medium plasticity fines.												
	21														
407.1	22														
	23				6	10 16 18	34				89				
405.1	24		Hard.												
	25		Groundwater was not encountered during Drilling. Borehole was grouted upon completion. Bottom of borehole at 25.0 ft bgs/Elev. 404.1 ft.												
403.1	26														
	27														
401.1	28														
	29														
399.1	30														
	31														
397.1	32														
	33														
395.1	34														
	35														
393.1	36														
	37														
391.1	38														
	39														
389.1	40														
	41														
387.1	42														
	43														
	44														

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASI

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

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Plate:
A-11B

LOGGED BY El Bhangoo	BEGIN DATE 6-20-11	COMPLETION DATE 6-20-11	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 122° 5' 1.32" / 37° 19' 28.88"
DRILLING CONTRACTOR EGS			BOREHOLE LOCATION (Offset, Station, Line) SEE SITE PLAN
DRILLING METHOD Hollow-Stem Auger			DRILL RIG CME 75
SAMPLER TYPE(S) AND SIZE(S) (ID) MC (2.5 inches I.D.) - SPT (1.4 inches I.D.)			SPT HAMMER TYPE 140 lbs
BOREHOLE BACKFILL AND COMPLETION Cement grout			GROUNDWATER READINGS — DURING DRILLING: Not encountered; AFTER DRILLING (DATE): Not monitored

HOLE ID	**RS-B-10**
SURFACE ELEVATION	445.5 ft NAVD88
BOREHOLE DIAMETER	8 in
HAMMER EFFICIENCY, ERi	60%
TOTAL DEPTH OF BORING	25.0 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Remarks
	0	SANDY lean CLAY (CL); stiff to very stiff; brown; moist; few GRAVEL; some fine SAND; low plasticity fines; gravels up to 1/4 inch in size.									
	1		1	11 12 14	26	10		PP = >4	83		
443.5	2										
	3										
441.5	4		2	11 12 14	26	10		PP = >4	89		
	5										
439.5	6										
	7	CLAYEY GRAVEL with SAND (GC); dense; brown; moist; little SAND; little fines; gravels up to 2 inch in size.									
437.5	8										
	9		3	22 23 50	73	9		PP = >4	67		
435.5	10										
	11										
433.5	12										
	13	SANDY lean CLAY (CL); hard; brown; moist; some fine SAND; low plasticity fines.									
431.5	14		4	15 18 34	52	30		PP = >4	72		
	15										
429.5	16										
	17										
427.5	18										
	19		5	11 50/6"	50/6	18			67		
	20										

(continued)

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASIN

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

This log is part of the report prepared by Parikh Consultants, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Depth	Sample Number	Blows per 6 in.	Blows per foot	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Recovery (%)	RQD (%)	Drilling Method	Casing Depth	Remarks
	20	▨	SANDY lean CLAY (CL); hard; brown; moist; some fine SAND; low plasticity fines.												
	21	▨	Lean CLAY with SAND (CL); hard; brown; moist; few fine SAND; low to medium plasticity fines.												
423.5	22														
	23														
421.5	24			☒	6	8 11 20	31	30		PP = >4	72				
	25														
419.5	26														
	27														
417.5	28														
	29														
415.5	30														
	31														
413.5	32														
	33														
411.5	34														
	35														
409.5	36														
	37														
407.5	38														
	39														
405.5	40														
	41														
403.5	42														
	43														
	44														

Groundwater was not encountered during drilling.

Borehole was grouted upon completion.
Bottom of borehole at 25.0 ft bgs/Elev. 420.5 ft.

LOG OF TEST BORING

PERMANENTE CREEK FLOOD PROTECTION PROJECT-RANCHO SAN ANTONIO BASIN

CUPERTINO, CALIFORNIA

PARIKH CONSULTANTS, INC.
Geotechnical & Materials Engineering

Date: 6/28/2011

Job No.: 2010-108-RSA

This log is part of the report prepared by Parikh Consultants, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

Plate:
A-12B

APPENDIX B

APPENDIX B

LABORATORY TESTS

Classification Tests

The field classification of the samples was visually verified in the laboratory according to the Unified Soil Classification System. The results are presented on "Log of Borings", Appendix A.

Moisture-Density

The natural moisture contents and dry unit weights were determined for selected undisturbed samples of the soils in general accordance with ASTM Test Method D 2216-98. This information was used to classify and correlate the soils. The results are presented at the appropriate depths on the "Log of Borings", Appendix A.

Atterberg Limits

The Atterberg Limits were determined for selected sample of the fine-grained materials. The result was used to classify the soils, as well as to obtain an indication of the expansion potential with variations in moisture content. The Atterberg Limits were determined in general accordance with ASTM Test Method D 4318-00. The result of the test is presented on Plate B-2, "Plasticity Chart".

Grain Size Classification

Grain size classification test (ASTM Test Method D 420) was performed on selected sample of granular soil to aid in the classification. The result is presented on Plates B-3A and B-3B, "Grain Size Distribution Curves".

Unconfined Compression Test

Strength tests were performed on selected undisturbed samples using unconfined compression machine. Unconfined compression tests were performed in general accordance with ASTM Test Method D 2166-00. The results are presented on "Log of Borings", Appendix A and on Plates 4A through 4C.

Consolidated Undrained Triaxial Compression Test

Consolidated Undrained Triaxial Compression tests (ASTM Test Method D 4767) were performed on selected relatively undisturbed samples. The test results are presented on Plates B-4D through B-4H.

APPENDIX B

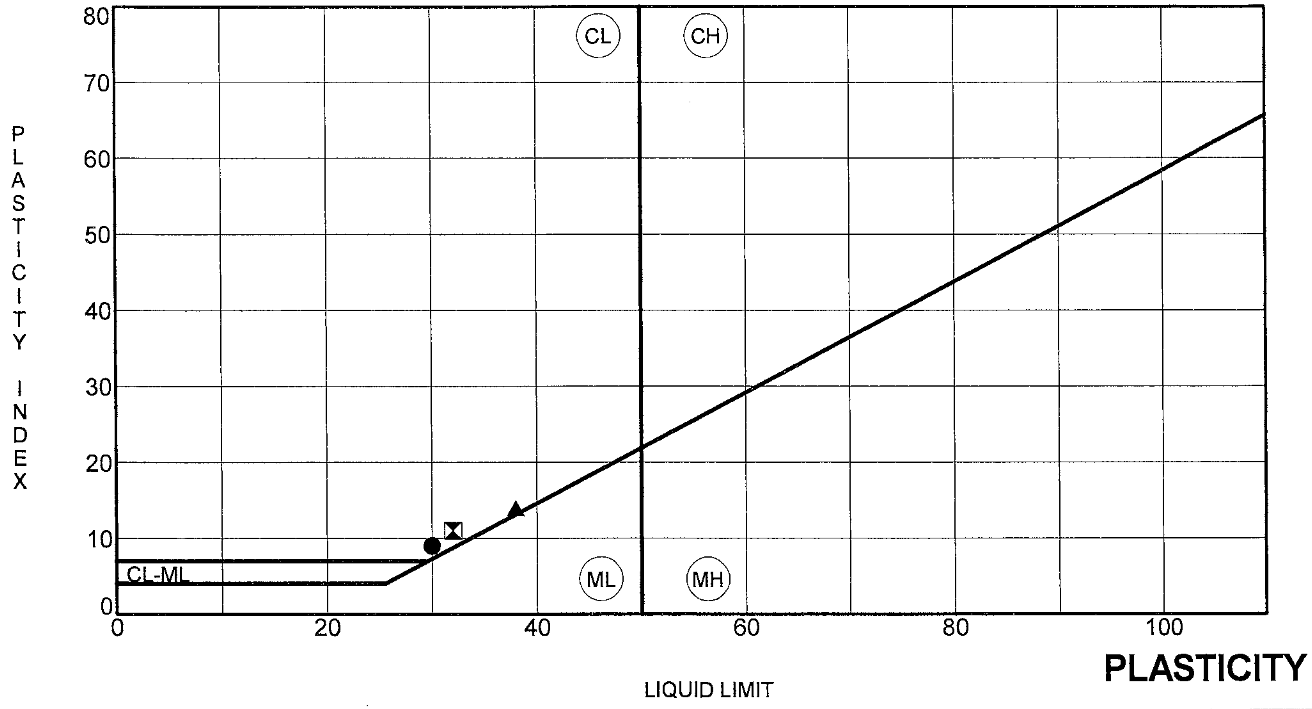
LABORATORY TESTS

Corrosion Test

Corrosion tests were performed on selected samples to determine the corrosion potential of the soils. The pH and minimum resistivity tests were performed according to California Test Method 643. Sulfate and chloride tests were performed by Sunland Analytical. The test results are presented on Plates B-5A and B-5B.

R-value Test

R-value tests were performed on bulk samples for pavement design. The tests were performed according to California Test Method 301. The test results are presented on Plates B-6A and B-6B.



PLASTICITY

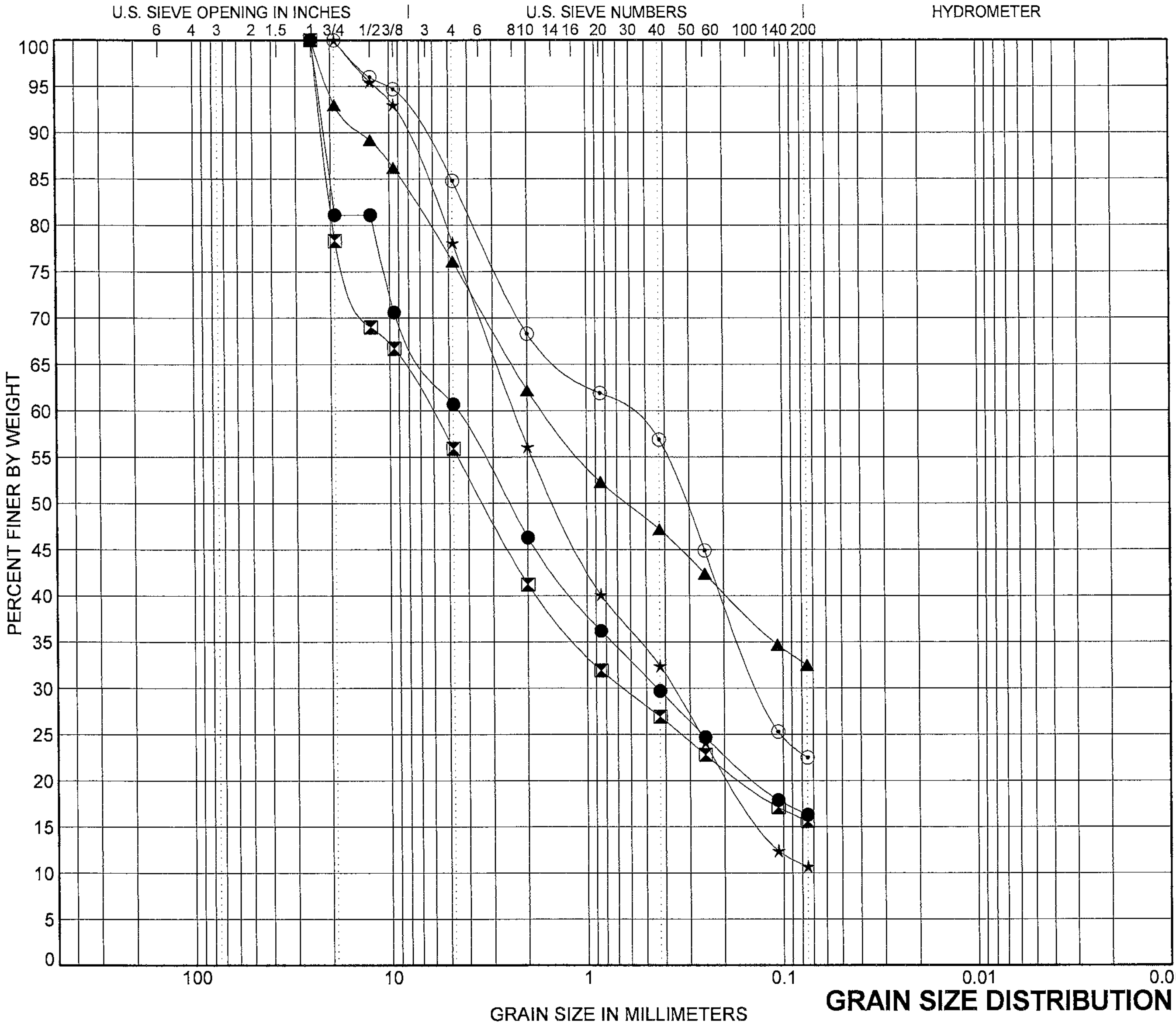
	BOREHOLE	SAMPLE #	DEPTH (ft)	LL	PL	PI	Fines	USCS Classification
●	**RS-B-1**	**MC-2**	**4.5**	**30**	**21**	**9**		**SANDY lean CLAY (CL)**
☒	**RS-B-2**	**MC-4**	**15.0**	**32**	**21**	**11**		**Lean CLAY (CL)**
▲	**RS-B-4 (w)**	**MC-4**	**14.5**	**38**	**24**	**14**		**Lean CLAY (CL)**

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO:2010-108-RSA

PLATE NO: B-2



GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING	SAMPLE #	DEPTH (ft)	Classification	LL	PL	PI	Cc	Cu
●	**RS-B-3**	**MC-2**	**5.0**	**CLAYEY SAND with GRAVEL (SC)**					
⊠	**RS-B-3 (w)**	**SPT-2**	**4.5**	**CLAYEY GRAVEL with SAND (GC)**					
▲	**RS-B-4 (w)**	**MC-6**	**24.5**	**CLAYEY SAND with GRAVEL (SC)**					
★	**RS-B-7**	**MC-2**	**4.5**	**Poorly graded SAND w/ SILT and GRAVEL (SP-SM)**				**0.88**	**35.85**
⊙	**RS-B-7**	**MC-6**	**24.5**	**CLAYEY SAND with GRAVEL (SC)**					

	BORING	SAMPLE #	DEPTH (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RS-B-3**	**MC-2**	**5.0**	**25**	**4.554**	**0.439**		**39.3**	**44.4**	**16.3**	
⊠	**RS-B-3 (w)**	**SPT-2**	**4.5**	**25**	**6.18**	**0.653**		**44.1**	**40.3**	**15.6**	
▲	**RS-B-4 (w)**	**MC-6**	**24.5**	**25**	**1.654**			**23.9**	**43.6**	**32.5**	
★	**RS-B-7**	**MC-2**	**4.5**	**19**	**2.331**	**0.365**		**21.9**	**67.4**	**10.7**	
⊙	**RS-B-7**	**MC-6**	**24.5**	**19**	**0.653**	**0.13**		**15.2**	**62.3**	**22.5**	

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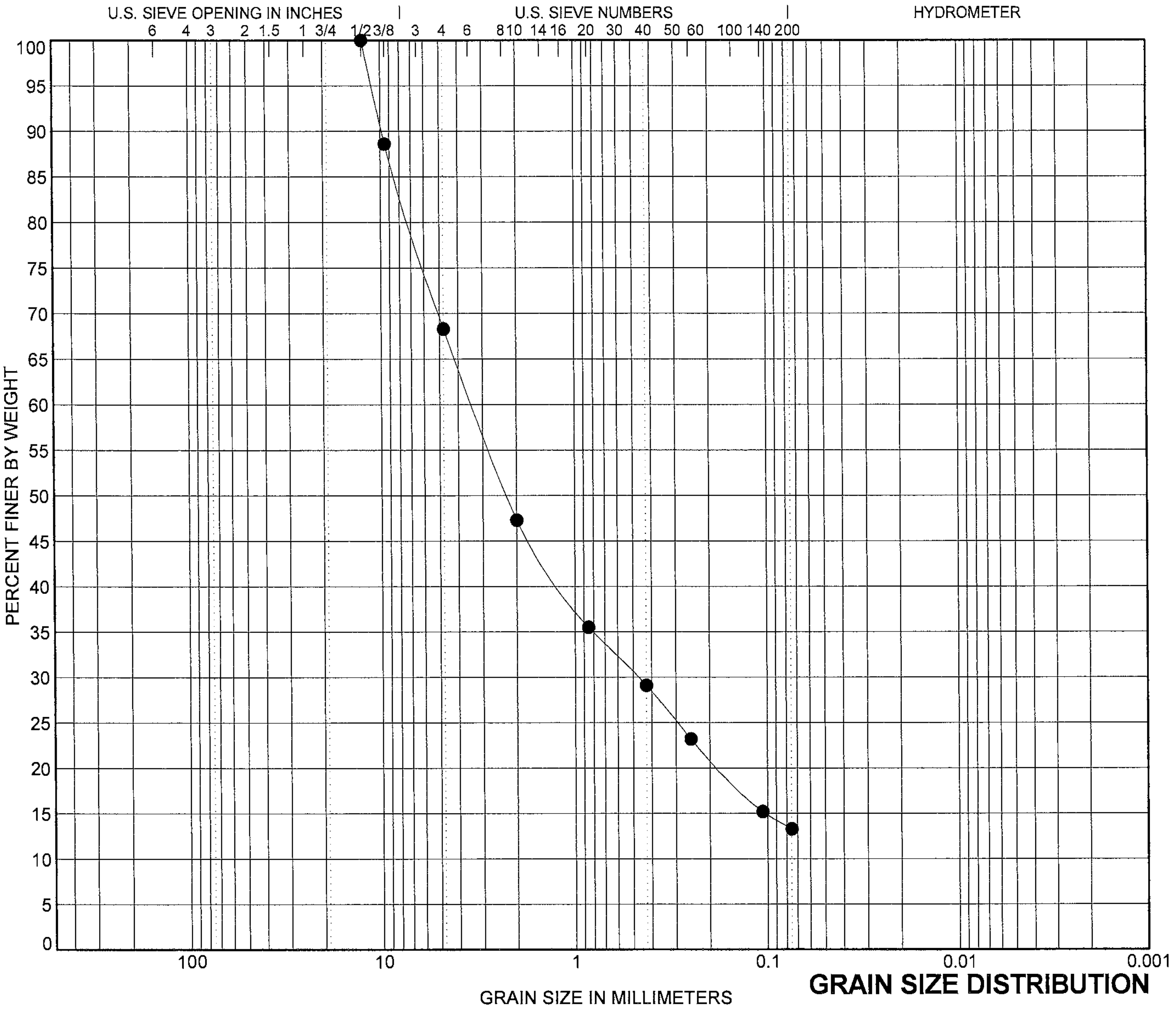
MATERIALS ENGINEERING

RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO:2010-108-RSA

PLATE NO: B-3A



GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING	SAMPLE #	DEPTH (ft)	Classification	LL	PL	PI	Cc	Cu
●	**RS-B-8**	**MC-2**	**4.5**	**SILTY SAND with GRAVEL (SM)**					

	BORING	SAMPLE #	DEPTH (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RS-B-8**	**MC-2**	**4.5**	**12.5**	**3.375**	**0.469**		**31.7**	**55.0**	**13.3**	

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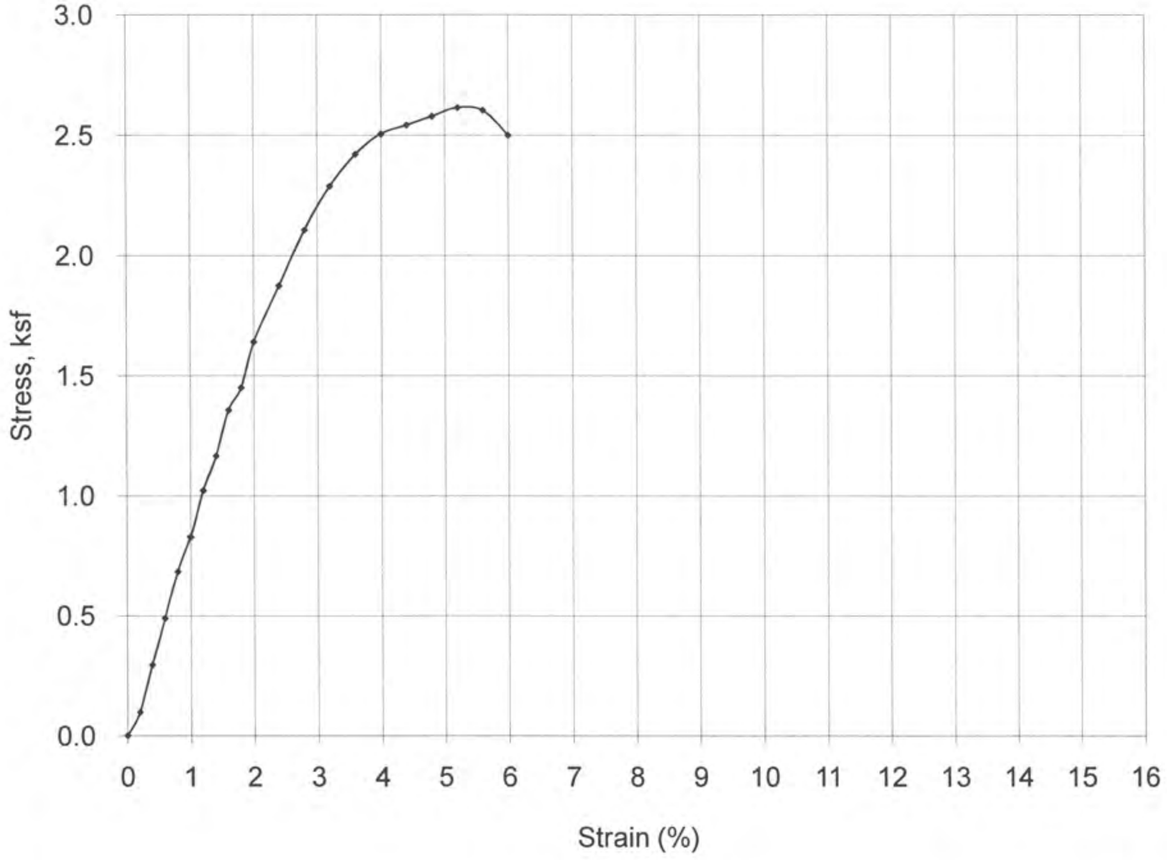
MATERIALS ENGINEERING

RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO:2010-108-RSA

PLATE NO: B-3B

UNCONFINED COMPRESSION TEST



Boring No.: RS-B-1

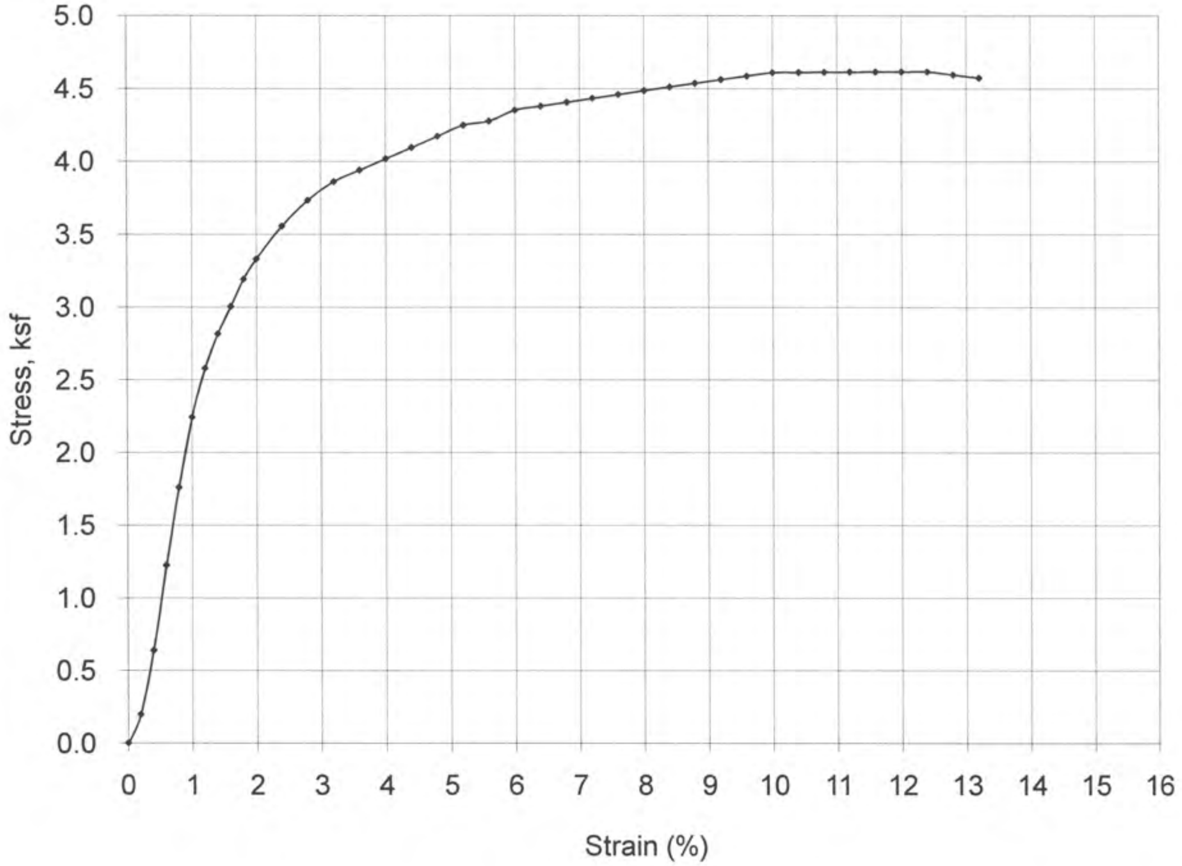
Sample No. : 7 **Maximum Strength (ksf):** 2.61

Depth (feet): 29.5 **Strain @ Failure (%):** 5.20

Material Description:
Stiff, Lean Clay with Sand and Gravel

PARIKH CONSULTANTS, INC. GEOTECHNICAL CONSULTANTS MATERIALS TESTING	**RANCHO SAN ANTONIO BASIN** **CUPERTINO, CALIFORNIA**
	JOB NO.: 2010-108-RSA
	PLATE NO.: B-4A

UNCONFINED COMPRESSION TEST

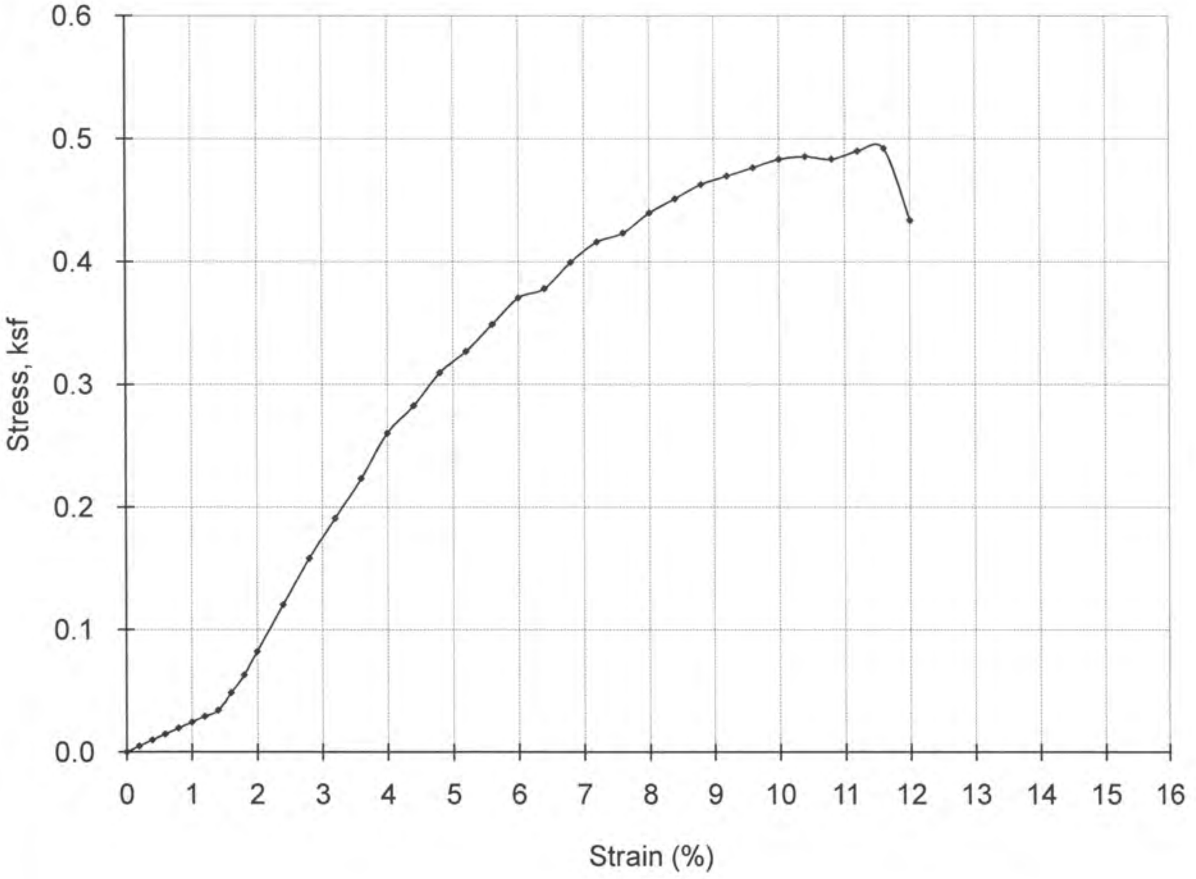


Boring No.:	RS-B-6		
Sample No. :	4	**Maximum Strength (ksf):**	4.57
Depth (feet):	14.5	**Strain @ Failure (%):**	13.20

Material Description:
Hard, Lean Clay

PARIKH CONSULTANTS, INC. GEOTECHNICAL CONSULTANTS MATERIALS TESTING	**RANCHO SAN ANTONIO BASIN** **CUPERTINO, CALIFORNIA**
	JOB NO.: 2010-108-RSA PLATE NO.: B-4B

UNCONFINED COMPRESSION TEST



Boring No.:	RS-B-8		
Sample No. :	4	**Maximum Strength (ksf):**	0.49
Depth (feet):	14.5	**Strain @ Failure (%):**	10.40

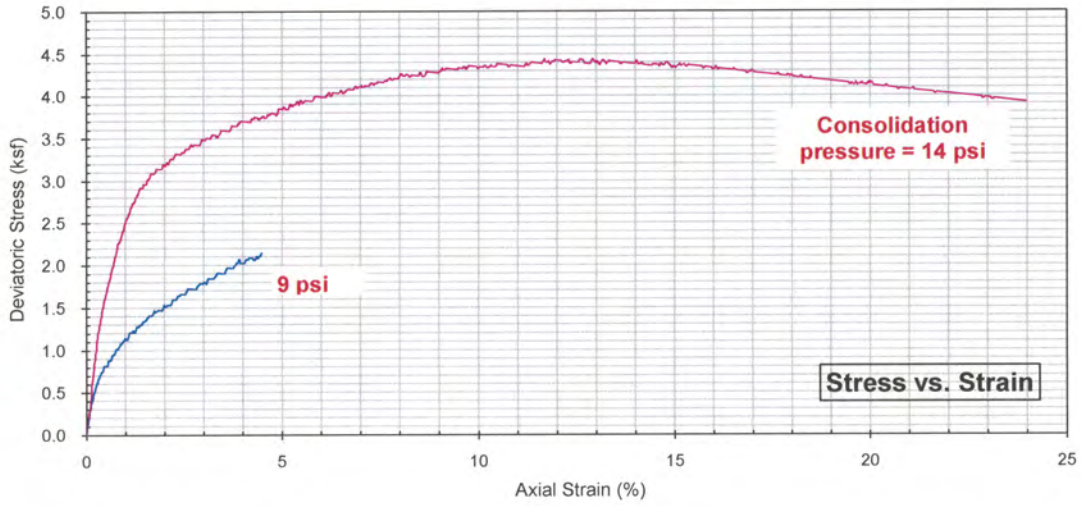
Material Description:
Very Soft, Silty Lean Clay with Gravel

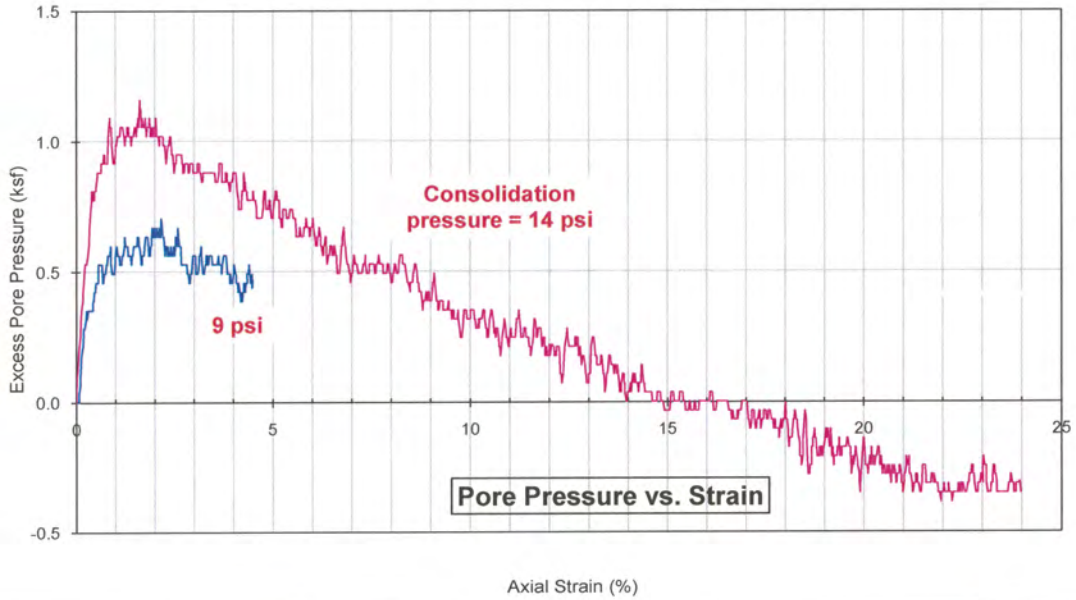
PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO.: 2010-108-RSA
PLATE NO.: 4C

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST





Boring No. RS-B-2

Sample No. 4

Elev. or Depth (ft) 15

Soil Description Lean Clay with Sand

	Stage	1	2
INITIAL	Moisture (%)	23.6	--
	Dry density (pcf)	102.7	--
	Diameter (inch)	2.416	2.625
	Height (inch)	5.0	4.2
AT TEST	Moisture (%)	--	23.7
	Area (sq. inch)	5.17	5.38
	Height (inch)	4.39	4.20
	B-value	1	1
	Total Cell Pressure (ksf)	6.05	6.77
	Back Pressure (ksf)	4.75	4.75
	Effective Cell Pressure (ksf)	1.3	2.0
	Strain Rate (%/min)	0.18	0.18
	Max. Deviator Stress (ksf)	2.16	4.49
	Strain @ Failure (%)	3.9	14.03
	Excess Pore Pressure @ Failure (ksf)	0.53	0.00
	σ_1' @ failure	2.93	6.50
	σ_3' @ failure	0.77	2.02

Remark:

Date: 10/1/2010
File Name: RS-B-2-#4

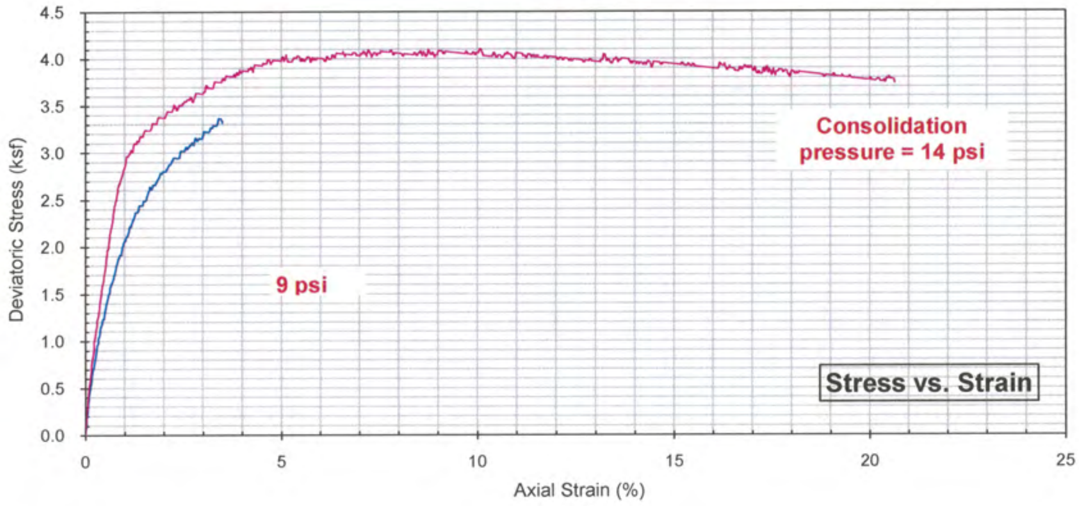
PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

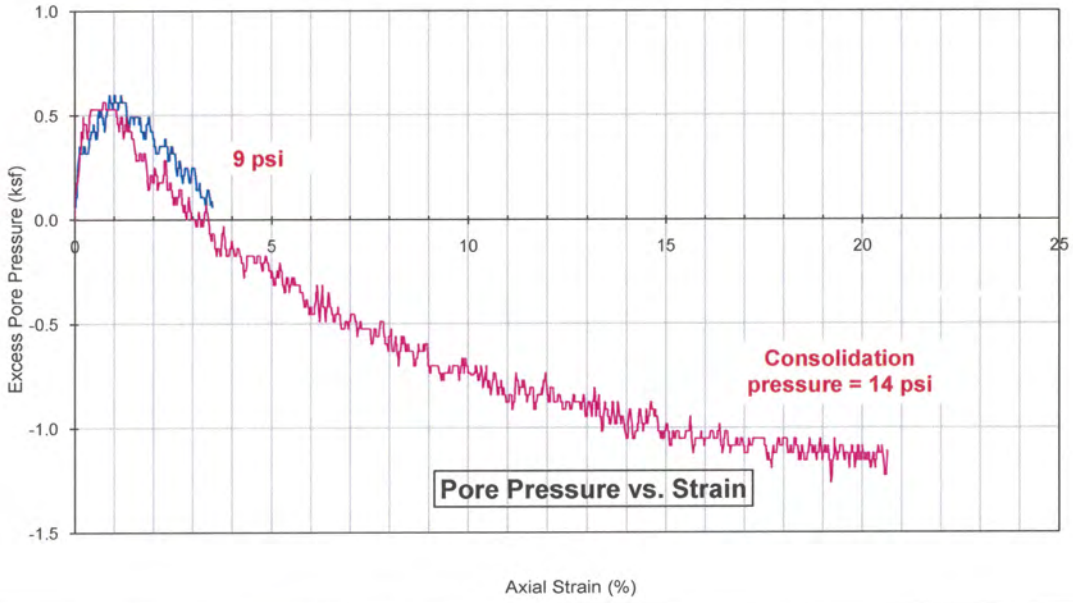
RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO.: 2010-108-RSA

PLATE NO. B-4D

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST





Boring No. RS-B-4

Sample No. 4

Elev. or Depth (ft) 14.5

Soil Description Lean Clay with Some Gravel

	Stage	1	2
INITIAL	Moisture (%)	22.9	--
	Dry density (pcf)	104.7	--
	Diameter (inch)	2.416	2.449
	Height (inch)	5.0	4.8
AT TEST	Moisture (%)	--	24.4
	Area (sq. inch)	4.54	4.70
	Height (inch)	5.00	4.83
	B-value	1	1
	Total Cell Pressure (ksf)	5.33	6.05
	Back Pressure (ksf)	4.03	4.03
	Effective Cell Pressure (ksf)	1.3	2.0
	Strain Rate (%/min)	0.18	0.18
	Max. Deviator Stress (ksf)	3.36	4.14
	Strain @ Failure (%)	3.5	7.81
	Excess Pore Pressure @ Failure (ksf)	0.18	-0.53
	σ_1' @ failure	4.48	6.68
	σ_3' @ failure	1.12	2.54

Remark:

Date: 10/1/2010
File Name: RS-B-4-#4

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

RANCHO SAN ANTONIO BASIN
CUPERTINO, CALIFORNIA

JOB NO.: 2010-108-RSA

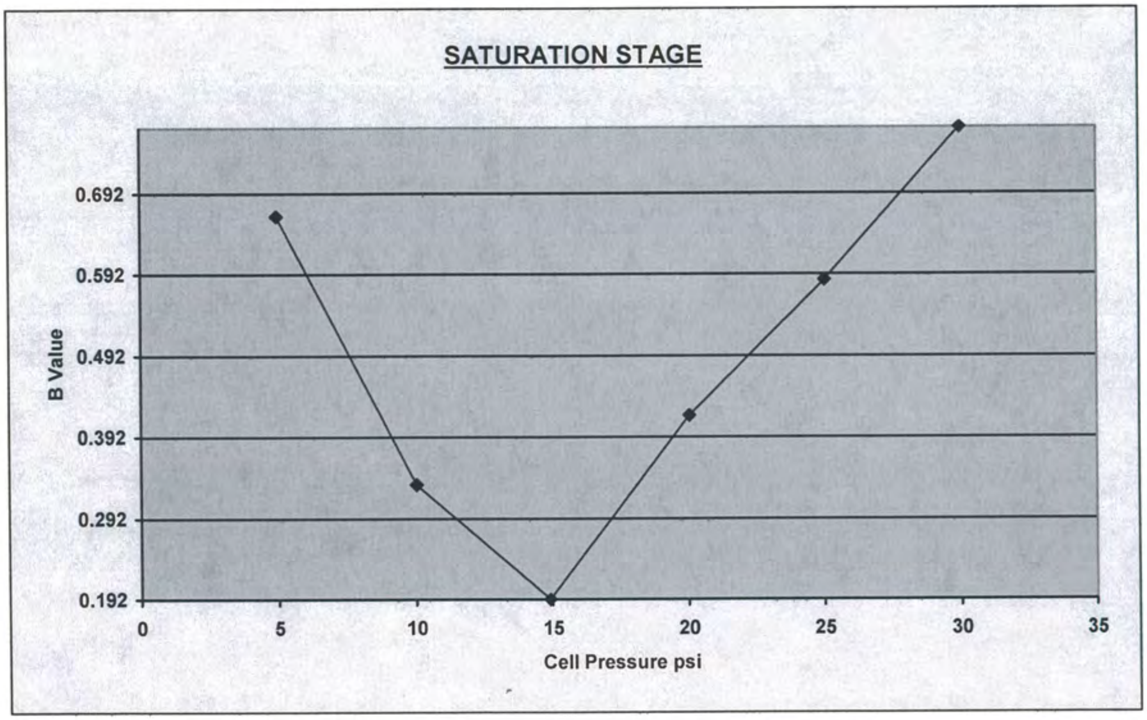
PLATE NO. B-4E

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

Client	HATCH MOTT MAC DONALD	**Lab Ref**	G695
Project	Permanente Creek Flood Protection Project	**Job**	2010-108-RSA
Borehole	RS-B09	**Sample**	2

Test Details			
Standard	**ASTM D4767 – 95 / AASHTO T297 - 94**		
Sample Type	Standard penetration test liner sample	**Lab. Temperature**	73.2 deg.F
Sample Description	SANDY LEAN CLAY, dark brown	**Particle Specific Gravity**	2.65 (Assumed)
Mounting Method	Wet		
Variations from Procedure	None		

Specimen Details			
Specimen Reference	A	**Description**	
Depth within Sample	0.0000 in	**Orientation within Sample**	
Initial Height	5.0000 in	**Initial Diameter**	2.4160 in
Preparation		**Moisture Content**	12.4 % (trimmings: 11.9 %)
Bulk Density	134.77 lb/ft3	**Initial Voids Ratio**	0.380
Dry Unit Weight	119.94 lbf/ft3	**Initial Degree of Saturation**	86.6%
Comments			



Saturation Method	Back Pressure Increments	**Cell Increments**	4.97,5.07,4.87,5.16,4.97,4.97,psi
Final Cell Pressure	30.01psi	**Back Increments**	2.93,5.11,4.87,5.15,5.01,psi

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

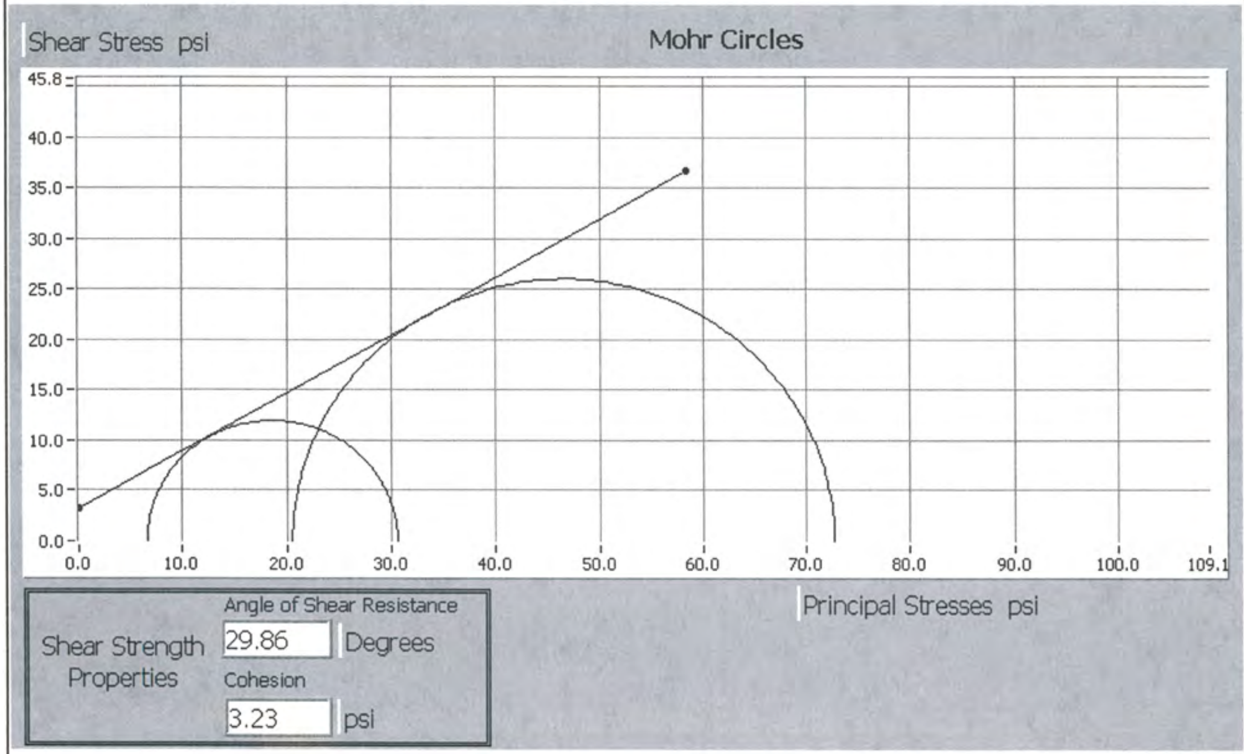
Final Pore Pressure	27.12psi	**Final B Value**	0.95

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

SUMMARY

Test Details	
Standard	ASTM D4767 – 95 / AASHTO T297 - 94

Specimen Details		
Specimen Reference	**Effective Minor Principal Stress (σ_3')**	**Effective Major Principal Stress (σ_1')**
A	6.65psi	30.59psi
B	20.56psi	72.70psi



Shear Strength Properties

Angle of Shear Resistance: 29.86 Degrees

Cohesion: 3.23 psi

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 12/17/2010
Date Submitted 12/13/2010

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 210108.10/PERM.CREEK Site ID : R5-B3#3 @ 10'.
Thank you for your business.

* For future reference to this analysis please use SUN # 59390-121099.

EVALUATION FOR SOIL CORROSION

Soil pH	7.50	
Minimum Resistivity	2.95 ohm-cm (x1000)	
Chloride	17.5 ppm	00.00175 %
Sulfate	1.4 ppm	00.00014 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

PLATE NO.: B-5A

Permanente

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/20/2011
Date Submitted 07/14/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : #2010-108-RSA PERMAN Site ID : RS-B-8 #3@9.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60523-123943.

EVALUATION FOR SOIL CORROSION

Soil pH	7.23	
Minimum Resistivity	1.05 ohm-cm (x1000)	
Chloride	13.8 ppm	00.00138 %
Sulfate	42.7 ppm	00.00427 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 06/20/2012
Date Submitted 06/13/2012

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2010-108-RSA/PERM.CR Site ID : RS-B-2#1 @ 2'.
Thank you for your business.

* For future reference to this analysis please use SUN # 62461-128599.

EVALUATION FOR SOIL CORROSION

Soil pH	6.60	
Minimum Resistivity	4.02 ohm-cm (x1000)	
Chloride	5.1 ppm	00.00051 %
Sulfate	4.4 ppm	00.00044 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

RECEIVED
JUN 22 2012
By

PLATE NO.: B-5C

R-value Test Report (Caltrans 301)

Job No.:	157-288	**Date:**	08/23/11
Client:	Parikh Consultants	**Tested**	MD
Project:	Permanente Creek Flood Protection Project - 2010-108-RSA	**Reduced**	RU
Sample	RS-B-7 @ 0-5'	**Checked**	DC
Soil Type:	Olive Brown Clayey SAND		

Initial Moisture,	11.0%
R-value by Stabilometer	18
Expansion Pressure	0 psf

Specimen Number	A	B	C	D
Exudation Pressure, psi	326	219	517	
Prepared Weight, grams	1200	1200	1200	
Final Water Added, grams/cc	45	65	32	
Weight of Soil & Mold, grams	3187	3218	3172	
Weight of Mold, grams	2066	2104	2088	
Height After Compaction, in.	2.5	2.58	2.41	
Moisture Content, %	15.2	17.0	14.0	
Dry Density, pcf	117.9	111.7	119.5	
Expansion Pressure, psf	0.0	0.0	12.9	
Stabilometer @ 1000				
Stabilometer @ 2000	120	138	100	
Turns Displacement	3.4	3.9	2.96	
R-value	20	10	32	

Remarks:

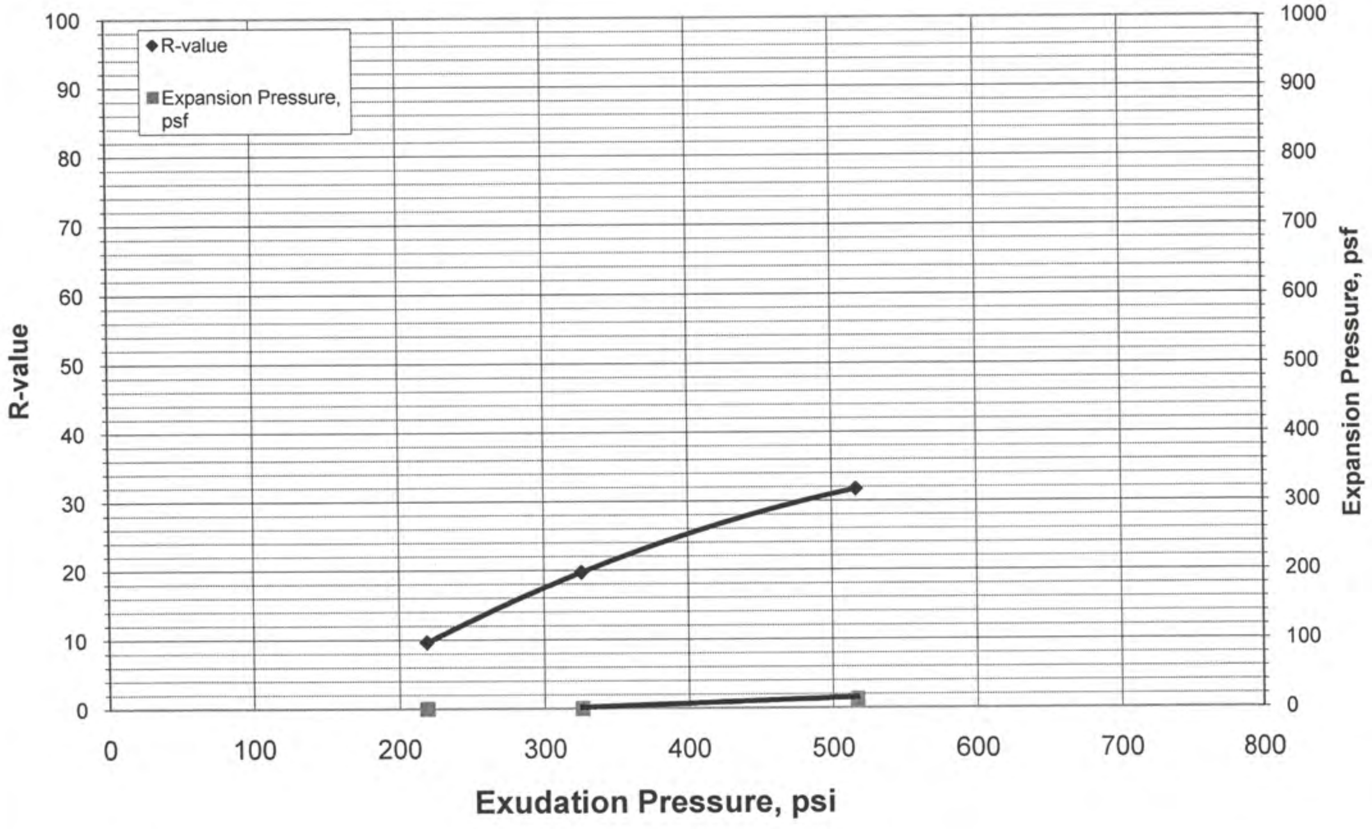


PLATE NO.: B-6A

COOPER
TESTING LABORATORY

R-value Test Report (Caltrans 301)

Job No.:	157-288	**Date:**	08/23/11	**Initial Moisture,**	16.0%
Client:	Parikh Consultants	**Tested**	MD	**R-value by Stabilometer**	19
Project:	Permanente Creek Flood Protection Project - 2010-108-RSA	**Reduced**	RU		
Sample	RS-B-8 @ 0-5'	**Checked**	DC	**Expansion Pressure**	20 psf
Soil Type:	Brown Clayey SAND				

Specimen Number	A	B	C	D
Exudation Pressure, psi	331	258	620	
Prepared Weight, grams	1200	1200	1200	
Final Water Added, grams/cc	50	65	35	
Weight of Soil & Mold, grams	3209	3206	3088	
Weight of Mold, grams	2100	2092	2086	
Height After Compaction, in.	2.64	2.72	2.37	
Moisture Content, %	20.8	22.3	19.4	
Dry Density, pcf	105.3	101.4	107.2	
Expansion Pressure, psf	30.1	17.2	129.0	
Stabilometer @ 1000				
Stabilometer @ 2000	124	127	93	
Turns Displacement	3.18	3.4	2.8	
R-value	20	18	36	

Remarks:

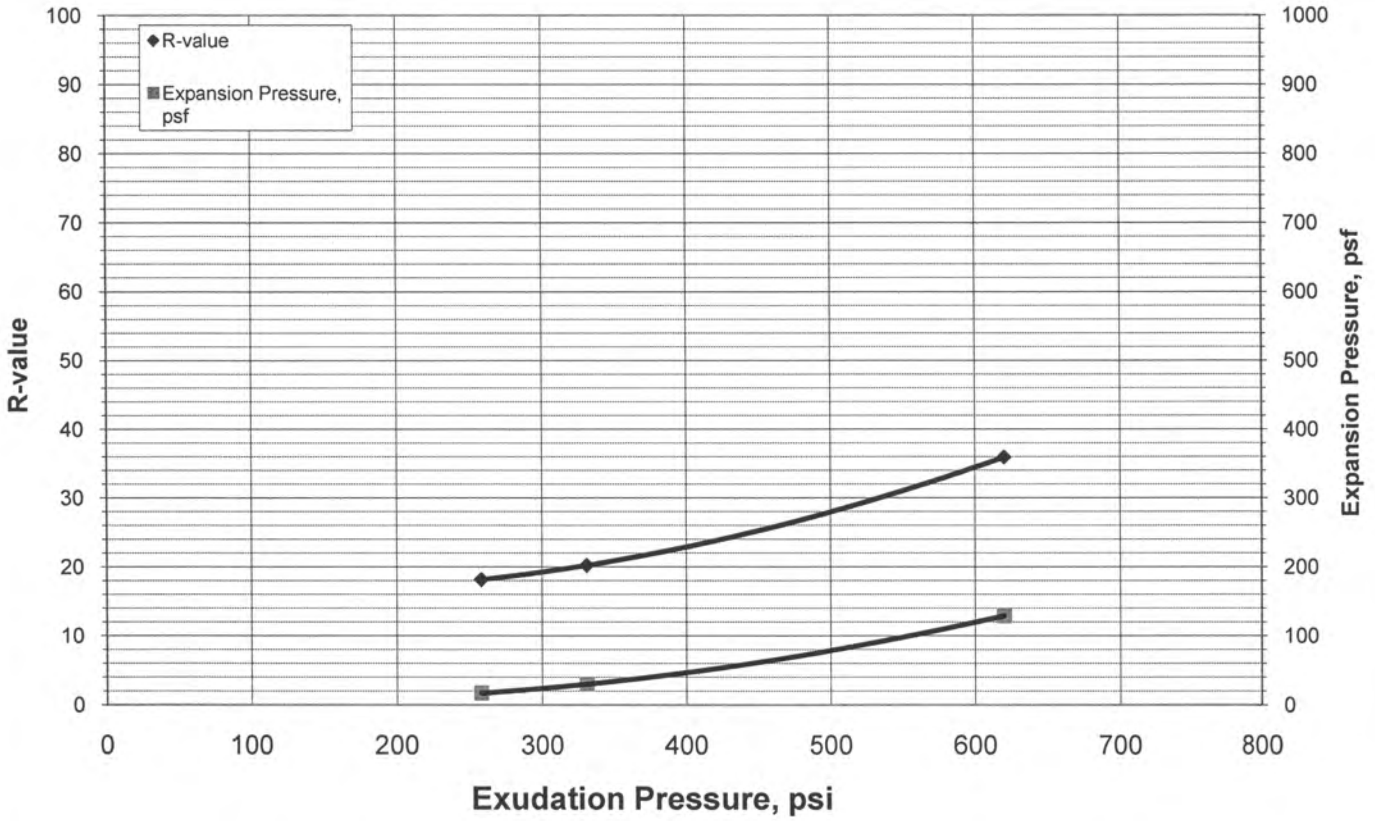


PLATE NO.: B-6B

APPENDIX C

Structural Pavement Design

PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME:	*Permanente Creek Flood Protection Project*
PROJECT NO.:	*2010-108-RSA*

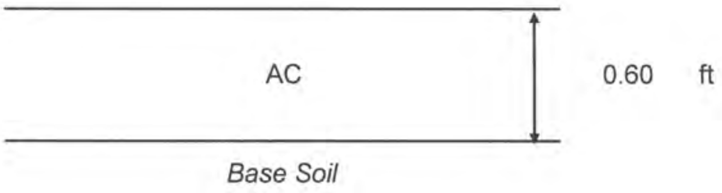
Design Case: Full depth AC

Design TI= ***5***
R_{BS}= ***15***

$GE_{AC} = 0.0032*TI*(100-R_{BS}) =$ 1.36
=> GE'_{AC}= 1.46 (add 0.1 ft safety factor)
=> AC Thickness= 0.56

=> AC Thickness= **0.60** ft (round up to the nearest 0.05 ft)

Design Section:



PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: *Permanente Creek Flood Protection Project*
PROJECT NO.: *2010-108-RSA*

Design Case: AC over AB

Design TI= ***5***
R_{BS}= ***15***
R_{AB}= 78

$GE_{AC+AB} = 0.0032*TI*(100-R_{BS}) =$ 1.36

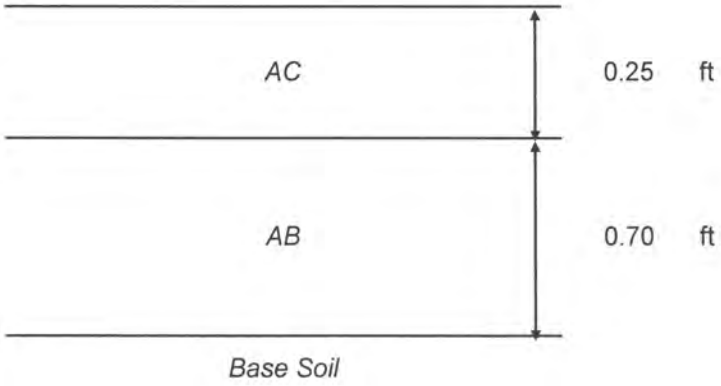
$GE_{AC} = 0.0032*TI*(100-R_{AB}) =$ 0.35
=> GE'_{AC} = 0.55 (add 0.2 ft safety factor)
AC Thickness = 0.22 ft

=> AC Thickness = **0.25** ft (round up to the nearest 0.05 ft)
$G_{f,\,AC}$ = 2.54
GE_{AC} = 0.63

$GE_{AB} = GE_{AC+AB} - GE_{AC} =$ 0.73
AB thickness= 0.66 ft

=> AB Thickness= **0.70** ft (round up to the nearest 0.05 ft)
GE_{AB}= 0.77 $G_{f,\,AB}$=1.1

Design Section:



PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: *Permanente Creek Flood Protection Project*
PROJECT NO.: *2010-108-RSA*

Design Case: AC over AB over AS

Design TI= ***5***
R_{BS}= ***15***
R_{AB}= 78
R_{AS}= 50

GE_{TOTAL} = 0..0032*TI*(100-R_{BS}) = 1.36

GE_{AC} = 0.0032*TI*(100-R_{AB}) = 0.35
=> GE'_{AC} = 0.55 (add 0.2 ft safety factor)
AC thickness = 0.22 ft

=> AC Thickness= **0.25** ft (round up to the nearest 0.05 ft)
$G_{f, AC}$= 2.54
GE_{AC}= 0.63

GE_{AB+AC} = 0.0032*TI*(100-R_{AS}) = 0.80
=> GE_{AC+AB}= 1.00 (add 0.2 ft safety factor)

GE_{AB} = GE_{AC+AB}-GE_{AC} = 0.37
=> AB thickness= 0.33

=> AB Thickness= **0.35** ft (round up to the nearest 0.05 ft)
GE_{AB}= 0.39 $G_{f, AB}$=1.1

GE_{AS} = GE_{TOTAL}-GE_{AB}-GE_{AC} = 0.34
=> AS Thickness= **0.35** ft (round up to the nearest 0.05 ft)

Design Section: